PRICING POLLUTION:

REVISING BRITISH COLUMBIA'S WASTE DISCHARGE PERMIT FEES

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PREFACE

This report was prepared as part of the background research undertaken by the Ministry of Environment in its review of waste discharge fee systems. The views and recommendations contained in the report are those of the author and do not necessarily reflect the views and policies of the Ministry.

ACKNOWLEDGEMENTS

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SECTION ONE

INTRODUCTION

1.1 BACKGROUND

Recently there has been a major shift in public opinion about the way in which governments should raise the revenues necessary for pollution control and environmental management. From an economic point of view it is the waste generator (polluter) who should bear the ultimate responsibility for his or her waste products (pollutants). As such, the revenues necessary to fund waste management and pollution control should come from the waste generators and not from government. To do otherwise would mean that the general public would be subsidizing the waste disposal costs of waste producers. Under these circumstances, the waste producers would have no incentive to either reduce their waste production or to find alternative waste disposal methods.

This view, that it is polluters and not government who should fund waste management, was formalized as the "polluter-pays principle" and adopted by all member nations of the Organization for Economic Cooperation and Development (OECD), including Canada. In its guiding principles, the OECD states:

> **The principle to be used for allocating costs of pollution prevention and control measures to encourage rational use of scarce environmental resources and to avoid distortions in international trade and investment is the so-called "Polluter-Pays Principle". The principle means that the polluter should bear the expenses of carrying the above mentioned measures decided by public authorities to ensure that the environment is in an acceptable state. In other words, the cost of these measures should be reflected in the cost of goods and services which cause pollution in production and/or consumption. (OECD, 1975).**

In response to the polluter pays principle, governments are now turning increasingly to the use of economic instruments as a means of pollution control and revenue generation. Included in the list of potential economic instruments are transferable (or marketable) discharge permits, environmental excise taxes (also know as product charges), deposit systems, and waste discharge fees. The potential application of the latter economic instrument, waste discharge fees, to British Columbia's environmental management problems is the focus of the this paper.[1]

1.2 PURPOSE AND OUTLINE OF THE REPORT

The purpose of this report has been to undertake three tasks. First, to provide a critical review of British Columbia's current waste discharge permit fee system. Second, to examine the types of discharge fee systems used in other jurisdictions and the results these systems have achieved. Third, to make recommendations on potential improvements to the province's current discharge permit fee system.

The remainder of this introductory section summarizes the theoretical economic arguments for waste discharge permit fees, the potential reaction of firm's to waste discharge fees, and the various objectives which a discharge fee system could be used to achieve. Section Two provides a review of the development of British Columbia's current waste discharge permit fee system and evaluates its ability to achieve the objectives of a theoretically "correct" discharge fee system. The next three sections present a review of the discharge fee systems used in Europe, Japan and the U.S. as a means of environmental control. This includes a review of the water pollution fee systems used in the Netherlands, France and West Germany, the air pollution fee systems of Norway, Japan and California's South Coast Air Quality Management District, and the solid and hazardous waste disposal fee systems used by several U.S. states. Section Six presents recommendations on potential revisions to British Columbia's current waste discharge fee system based on the lessons learned from the review of other jurisdictions.

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[1] Readers interested in a review of transferable discharge permits are directed to Tietenberg (1985) or Hahn (1989). A review of environmental excise taxes and deposit systems can be found at Stone (1990).

1.3 ECONOMIC ASPECTS OF POLLUTION

When the production or consumption of a good imposes a cost on some unrelated party, a negative externality is said to exist. The classic example of a negative externality is pollution. For example, a manufacturer in the production of a good may emit large quantities of air pollutants. If the costs to society resulting from the air emissions are not borne by the polluting firm, then these costs are said to be external to the firm (thus, an externality) and these costs will not be included in the firm's production decisions. Examples of the external costs imposed by polluters include injury to human health, damages to crops and forests, damage to buildings and structures, depressed property values, and lost environmental amenities.

The effect of a negative externality on resource allocation can be seen using a simplified economic model of a market for a hypothetical good. Figure 1-1 shows a model of a competitive market where no negative externalities exist.[2] The supply curve S shows the quantity of the good that producers would be willing and able to produce for any given price while the demand curve D shows the quantity of the good consumers would be willing and able to purchase at any given price. The intersection of the two curves is the point of market equilibrium where the quantity demanded is exactly equal to the quantity supplied. At this point, price P* and quantity Q* are said to be the market clearing price and quantity.

In Figure 1-2, a negative externality is introduced into our simplified model. The negative externality causes a divergence between the private costs of production faced by the firm and the total social costs borne by society. In Figure 1-2, the curve S_p represents the supply curve for the good where only the private costs to the producing firms are included. Supply curve S_S represents the supply curve for the good where all costs, private and social (or internal and external), are included. The

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[2] The basic assumptions of perfect competition are:
a. both consumers and producers are price takers;
b. the product of all producers are identical (homogeneous products);
c. all resources are free to move in and out of the market; and
d. both producers and consumers have perfect knowledge of market prices and costs.
See, for example Ferguson and Gould (1975) for a more complete discussion of the concept of perfect competition.

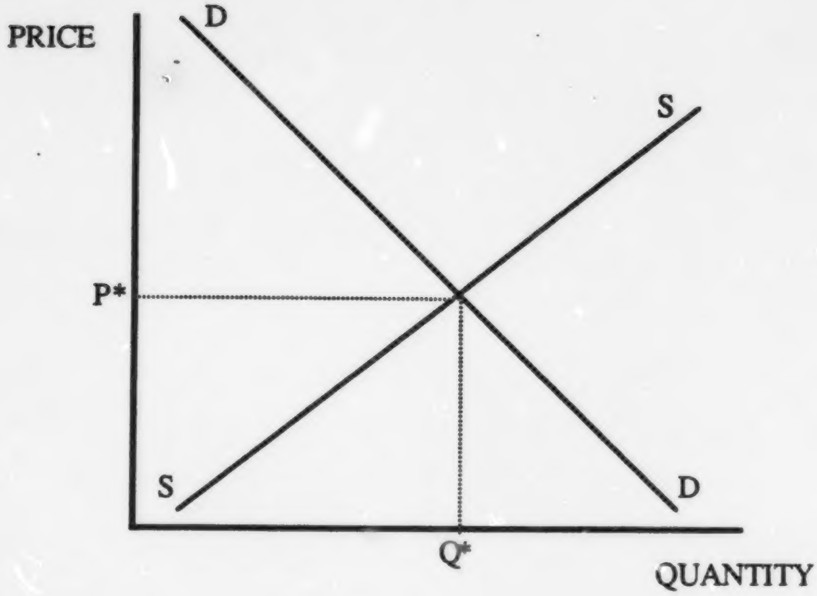

Figure 1-1

A Hypothetical Market

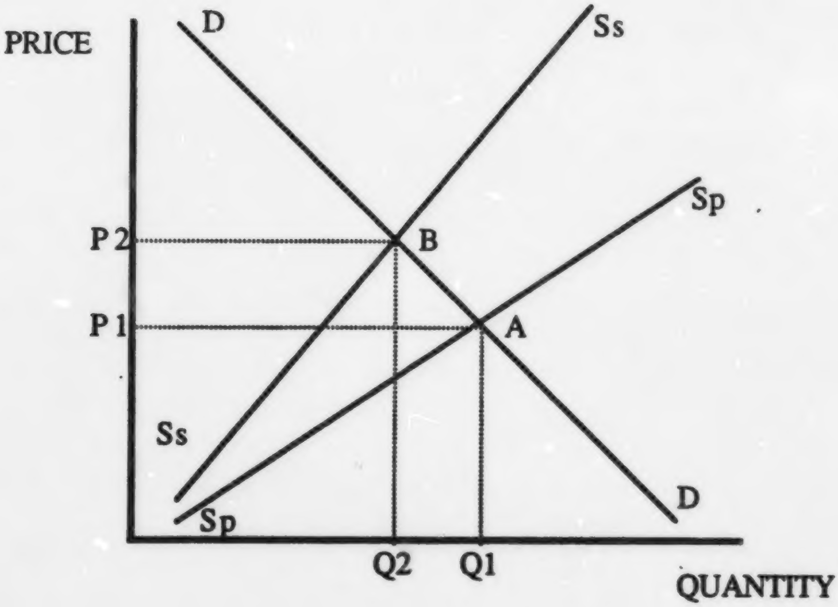

Figure 1-2

Divergence Between Private and Social Costs vertical difference between the two curves represents the external cost of production (or the marginal cost of the pollution damage) to society at each level of production. If the firms do not have to bear their external costs of production, then supply curve S_p will be the relevant curve and the market will come to a equilibrium at point A, with price P_1 and quantity Q_1. However, if the firms were made to bear the full costs of their production, supply curve S_s would be the relevant curve and a market equilibrium would be reached at point B, with price P_2 and quantity Q_2. From society's point of view, equilibrium point A is economically inefficient as not all costs associated with the production of the good are included in the production and consumption decisions. Too much of the good is being produced at too low a price. Instead point B is the optimum level of production as all costs, both private and social, are included in the production and consumption decisions.

To correct this market inefficiency, society must have a means of making polluters internalize their external pollution costs. This could be done by charging firms for their waste discharges through a system of waste discharge fees set equal to the polluter's marginal external cost of production. The fees would internalize the firm's external costs, causing the private supply curve S_p in Figure 1-2 to shift upwards to become the same as the social supply curve S_s. In this way, the market would be returned to the optimum level of production and economic efficiency would be restored.

The use of a waste discharge fee system, to correct the problem of negative externalities caused by pollution, requires that government have an estimate of the marginal cost of pollution damage. Rarely do governments have this information as external costs are very difficult to measure.[3] Indeed, if the discharge fees are set too high, so that the private supply curve is shifted well above the social cost curve, then it is possible that the economic efficiency of the market could be made worse. Instead, governments have relied on proxy measures, such as the average cost of treating discharges to a specified level of quality, to approximate the marginal cost of pollution damage.

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[3] See Freeman (1979) for a review of the techniques available for estimating environmental amenity values and costs.

Another economic aspect of pollution stems from the ability of nature to assimilate limited amounts of many pollutants without causing environmental damage. For example, the discharge of limited quantities of organic matter into water courses can be broken down by natural organisms without causing harm to the aquatic ecosystem. However, if the discharges are too great, the biological oxygen demand resulting from the discharges can overwhelm and destroy the ecosystem. This natural assimilative capacity of the environment should be viewed as a valuable natural resource and treated in a manner similar to other valuable natural resources such as petroleum, natural gas or timber. Currently, the environment as a resource is used by polluters free of charge which will unquestionably lead to its overuse. Waste discharge fees would force polluters to account for their use of this resource which would result in greater conservation of this assimilative capacity and help to prevent the overuse of this resource.

1.4 THE EFFECTS OF WASTE DISCHARGE FEES ON POLLUTERS

Firms create pollutants as a residual product during their production processes.[4] During these processes, primary and side products are generated.[5] The side products can in turn be broken down into by-products and waste products. A waste product differs from by-product in that the marginal cost of recovering the waste product is greater than its marginal return. In other words, waste products are those side products which a firm does not find profitable to recover. Pollution occurs when the waste products are discharged into the environment.

Because of the common property nature of the environment, firms can, in many cases, freely discharge their wastes into the environment. A common property resource is one where the public has free and open access to its use. When property rights are specified in this manner, it usually leads to the overuse of the resource or, as Garret Hardin (1968) has coined it, to the "tragedy of the commons". Also, when the property rights to the environment are specified in this manner, firms have no incentive to undertake pollution abatement measures. Rather market forces will create an incentive for firms not to undertake abatement measures. As pollution abatement can involve substantial costs, any firm undertaking abatement measures may find itself at a competitive disadvantage with respect to firms who choose not to abate their pollution discharges.

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[4] While the discussion will focus on the pollution from industries, the same arguments will hold for pollution generated by municipalities or individual households.

[5] The terminology used here has been taken from Ethridge (1973).

The introduction of a waste discharge fee system takes away the right to freely discharge wastes and, by attaching a price to waste discharges, causes firms to conserve on their use of environmental resources. The extent to which an individual firm will undertake abatement measures in response to a discharge fee system will depend on the firm's cost of pollution abatement relative to the discharge fee. Figure 1-3 show a marginal abatement cost curve for a hypothetical firm. The curve shows the marginal, or incremental, cost of undertaking increasing levels of waste abatement. As shown for our hypothetical firm, the incremental costs continually rise as more abatement measures are undertaken and, typically, rise very steeply as complete pollution abatement is approached. If a fee per unit of pollution discharged is introduced, a firm would increase its abatement measures until the marginal cost of abatement was equal to the fee. For example, in Figure 1-3, the introduction of a discharge fee equal to P per unit of pollutant discharged would cause our hypothetical firm to undertake abatement measures equal to Q percent of total discharges. At levels of waste abatement less than Q, the firm would find it cheaper to control its wastes rather than discharge them at a cost of P per unit of waste. Thus, the firm would increase its abatement measures until level Q is reached at which point the firm would be indifferent to paying the fee or to paying the abatement costs since the two are equal. However, the firm would not increase its abatement measures past Q as the marginal cost of additional abatement measures would be greater than the discharge fee.

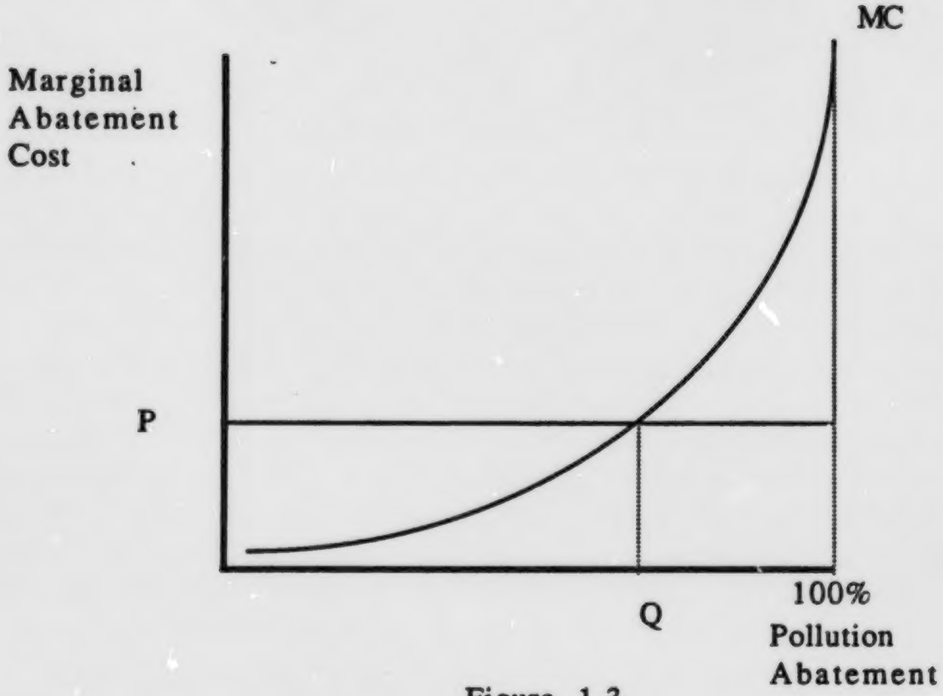

Figure 1-3
A Marginal Pollution Abatement Cost Curve

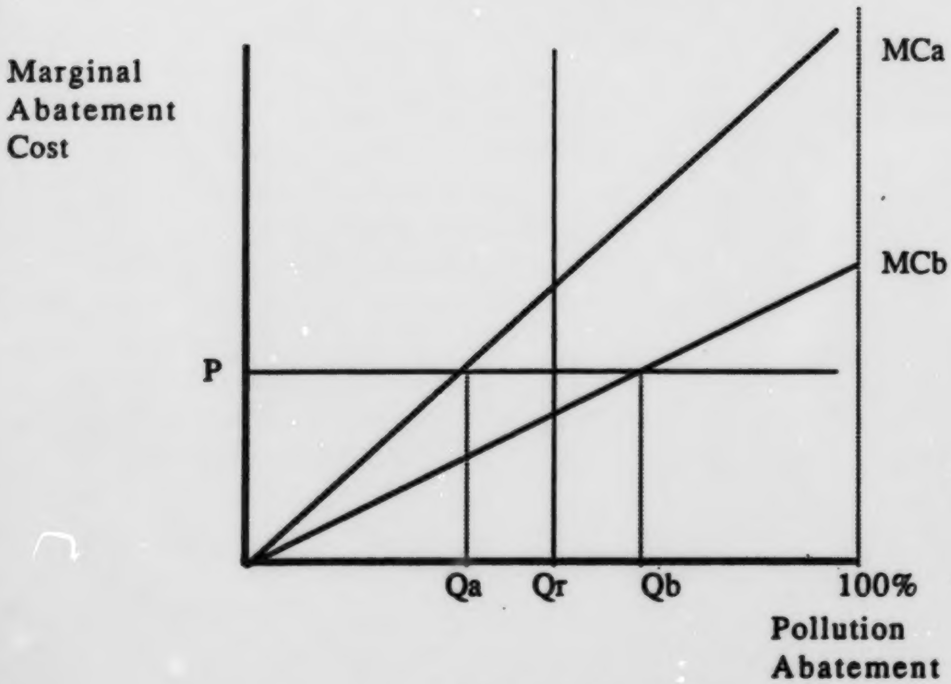

Figure 1-4
Discharge Fees With More Than One Firm

1.5 DISCHARGE FEES AS A SUBSTITUTE FOR DIRECT REGULATION

Economists have long argued that a system of waste discharge fees could achieve the same results as the more traditional permit/regulatory control approach to pollution control but at a lower total cost to society.[6] Their argument stems from the fact that the costs of pollution abatement vary significantly between both firms and industries. Consider the case shown in Figure 1-4 where we have two firms, A and B, each discharging equal amounts of wastes. The marginal cost of undertaking pollution abatement measures for each firm is shown as MC_a and MC_b respectively.[7] Note that firm A has a much higher marginal abatement cost schedule than firm B meaning, of course, that it is much more expensive for firm A to undertake pollution abatement measures than firm B. Now suppose that the government had directed both firms by regulation to each undertake abatement measures equal to Q_R. The costs for firm A to comply with this regulation would be much greater than it would for firm B. From society's viewpoint, it would be better if firm B undertook more abatement measures, because it has the lowest abatement costs, and firm A undertook less.

An alternative to the direct regulatory approach would be to introduce a waste discharge fee of P. In this case, firm A would undertake abatement measures equal to Q_A and firm B measures equal to Q_B. Note that in this case Q_A plus Q_B equals 2 x Q_R so that the same total abatement level is achieved by both approaches. However, under the discharge fee approach, the total abatement costs to society would be less than that imposed by the regulatory approach as the abatement cost savings to firm A are much greater than the added abatement costs to firm B. The fee system is also equitable for both firms as firm A, which is now discharging more wastes than firm B, is also paying much more in total discharge fees than firm B.

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[6] See for example, Kneese and Bower (1968) or Baumol and Oates (1979).

[7] For simplicity it will be assumed that both firms have linear cost abatement curves rather than the exponential cost curves shown in Figure 1-3. This simplification will not alter the analysis.

Another advantage waste discharge fees would have over direct regulatory controls is their dynamic rather than static nature over time. Once direct regulatory controls are in place to reduce a firm's discharges to a specified level, the firm has no incentive to further reduce its discharges. Thus, the regulatory approach is viewed as being static. On the other hand, discharge fees provide firms with an ongoing incentive to reduce their discharges whenever possible. Thus, the discharge fee approach is viewed as being dynamic.

The use of discharge fees as a means of pollution control is not, of course, without disadvantages. Foremost perhaps is that government would require detailed knowledge of each industry's marginal abatement cost curves in order to set the correct fee level required to meet some specified environmental quality objective. Obviously, this information would be difficult and costly to collect.[8] Some economists have suggested as an alternative that fees be originally set quite low, in order to gauge industry's response, and that the fees be raised over time until the desired level of abatement has been reached. Another disadvantage of fees stems from inflation which could erode the economic incentive effect of the fees and which would require periodic review of the fee level in order to maintain their effectiveness.

In summary, the major advantages of the waste discharge fee approach to pollution control is that it will achieve a given level of pollution abatement at the lowest total cost to society and will provide a ongoing economic incentive for firms to find new ways to reduce their waste production. The major disadvantage is that without detailed knowledge of the firms' marginal abatement cost curves, it is not possible to guarantee beforehand what level of abatement a given fee will achieve.

Despite the significant advantages waste discharge fees offer, they will not be a panacea for all pollution problems. Highly toxic wastes, for example, can cause great damage even when only minute quantities are released. For these substances, a regulatory ban on their discharge would probably be a more efficient control approach than would discharge fees.

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[8] In fairness it must be stated that similar detailed technical information is also required for the direct regulatory approach to pollution control.

Another example is a city which experiences a sudden build up of air pollutants due to an inversion layer in the atmosphere. In this case, a temporary restriction of emissions would probably be best mechanism for handling this type of environmental problem. There are other examples of where the direct regulatory approach may be superior to discharge fees. Rather than viewing discharge fees as a substitute to the direct regulatory approach, it might be best to view them as complementary instruments for pollution control which can be used together to achieve environmental objectives.

1.6 THE OBJECTIVES OF A WASTE DISCHARGE FEE SYSTEM

The foregoing discussion of the economic aspects of pollution and the theoretical response of firms to waste discharge fees suggests that governments could impose discharge fees to achieve one or more of the four following objectives.

1. To Improve Economic Efficiency in Resource Allocation

The introduction of waste discharge fees would cause firms to take account of, or internalize, the external costs their waste discharges impose on society. The fees would also promote the conservation of the scarce assimilative capacity of nature to absorb pollutants. The degree to which the fees will help to achieve economic efficiency in the allocation of resources will depend on how closely the fees are set to approximate the marginal external costs associated with the discharges.

2. As An Incentive to Reduce Waste Production

As described above, the fees would provide firms with an ongoing economic incentive to reduce their waste discharges whenever possible. The degree to which a firm will reduce its waste discharges in response to the fees will be determined by the level of the fee relative to the firm's marginal cost of pollution abatement.

3. As A Cost Recovery Mechanism

The discharge fees could be employed to raise the revenues needed to cover, in whole or in part, the administration and operation of government waste management functions, to collect a resource rent, or to fund the compensation of people suffering the effects of the pollution discharges.

4. To Achieve Equity

The discharge fees could be used to provide a more equitable sharing of the costs resulting from pollution in at least three ways. First, those causing the pollution could be made to bear the costs of the damages resulting from their discharges. Second, the fees would promote inter-industry equity as those industries polluting the most would pay the most in fees. Third, the revenue derived by the fees could be used to compensate those suffering the effects of pollution.

SECTION TWO

BRITISH COLUMBIA'S CURRENT WASTE MANAGEMENT FEE SYSTEM

2.1 INTRODUCTION

The purpose of this section is to review the current system of waste management fees employed in British Columbia and to compare the current system to the idealized discharge fee system described in Section One. Before discussing the current fee system, a review of British Columbia's waste management permit system is presented as a necessary background. The waste permit fee system is then described and critically examined.

2.2 BRITISH COLUMBIA'S WASTE MANAGEMENT PERMIT SYSTEM

The primary legislative tool for the control of pollution in British Columbia is the *Waste Management Act*[1], which came into force on June 25, 1982, and replaced the previous *Pollution Control Act of 1967*.[2] The *Waste Management Act* established a strict liability against the discharge of wastes into the environment unless authorized by a waste management permit.[3] The management of the waste discharge permit system is the responsibility of the Environmental Protection Division of the Ministry of Environment and its decentralized system of Regional Waste Managers. On the receipt of an application, a manager may issue a discharge permit subject to any "requirements for the protection of the environment that he considers advisable...".[4] The permit requirements can specify that the permittee:

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[1] *Waste Management Act*, S.B.C. 1982, c. 41.

[2] *Pollution Control Act of 1967*, S.B.C. 1967, c. 34.

[3] Section 3 (1.1) of the *Act* states "Subject to subsection (3) no person shall, in the course of conducting an industry, trade or business, introduce or cause or allow waste to be introduced into the environment." Section 3 (3) (a) allows the "disposition of waste in compliance with a permit, approval, order or the regulations, or with a waste management plan approved by the Minister." In this report, "permit" will be taken as including permits, approvals, orders, and waste management plans which authorize the discharge of wastes.

- undertake to repair, alter, improve existing works, or construct new works and that he submit the plans and specification for the works specified in the permit;
- post security in the amount, form and subject to the conditions required by the permit;
- monitor the method of handling, treating, transporting, discharging and storing of wastes;
- conduct studies and report information;
- handle, treat, transport, discharge or store wastes using specified procedures or requirements; and
- recycle certain wastes to recover certain resources, including the energy potential, from wastes.

In setting the conditions for a waste management permit, in particular the maximum quantities and concentrations of pollutants allowed to be discharged, the waste manager consults the Pollution Control Objectives for the relevant industry group.[5] Pollution control objectives have so far been developed for five industry groups:

- the chemical and petroleum industries;
- the mining, smelting and related industries;
- the forest products industry;
- the food-processing, agriculturally oriented, and other miscellaneous industries; and
- municipal type waste discharges.

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[4] Section 8 (1) of the *Act.*

[5] The pollution control objectives were developed to resolve what technical considerations and measures would be required of the various industry groups in order to meet the requirements of the *Pollution Control Act of 1967* which was the forerunner to, and replaced by, the *Waste Management Act.*

A separate permit is required for discharges to each environmental medium, (air, land and water) and for the storage of special wastes.[6] Thus, a firm could require a total of four waste permits for a single site. As of November 1, 1989, there were a total of 3,358 active waste permits comprised of:

• Air Emission Permits	1,043
• Effluent Discharge Permits	1,442
• Refuse Permits	856
• Special Waste Storage Permits	17

The requirement for a special waste storage permit was only recently been introduced, thus the small number of storage permits approved so far.[7] The number of storage permits is expected to increase significantly over the next two years.

2.3 COSTS OF MANAGING THE PERMIT SYSTEM

There are substantial costs incurred by the Ministry of Environment in operating and managing the waste permit system. For example, the expected 1990/91 permit system budget has been set at $21 million. These monies are used to pay for:

- Processing Permit Applications - A permit application, when received, requires administrative processing of the application itself and a detailed technical review of the discharges of the permit application. The technical review includes a review of the permit application information, a site inspection, the circulation of the permit application for outside agency review[8], the receipt and review of outside agency and other concerned parties' comments, and the preparation of the final technical report. If the permit application is approved, a permit is prepared which details all permit requirements.

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[6] Special wastes are defined as "those wastes which due to their nature and quantity are potentially hazardous to human health and/or require special disposal techniques to eliminate or reduce the hazard" (Ministry of Environment, Special Wastes Fact Sheet).

[7] The *Special Waste Regulation*, B.C. Reg. 63/88, under the *Waste Management Act* became effective on April 1, 1988.

- Monitoring of Waste Discharges - The permit can require that monitoring data be collected and submitted for review by the Regional Waste Manager. In addition, each permit, depending on its potential environmental impact and its past history of performance, has a regular series of site inspections by the regional staff.

- Enforcing Permit Requirements - If a violation of permit requirements is suspected, evidence must be gathered, a case prepared and prosecution take place.

2.4 THE CURRENT WASTE MANAGEMENT PERMIT FEE SYSTEM

The *Waste Management Act* contains a provision which allows for the collection of fees and costs from permit holders.[9] A discharge permit fee system was first introduced on September 1, 1987, by the *Waste Management Fees Regulation*.[10] The regulation established an annual fee for each waste discharge permit held and an application fee payable when applying for a waste management permit. The application fee is the same amount as the annual fee for the permit applied for. Currently, no fee is collected for a special waste storage permit. In addition, the regulation specifically exempts the following from the permit fees:

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[8] Other agencies to which the permit is circulated includes the Regional Fish and Wildlife Manager, the Water Management Branch, Ministry of Agriculture and Fisheries, Ministry of Energy, Mines and Petroleum Resources, the Local Health Officer, Environment Canada, and the appropriate Regional District.

[9] Section 33 of the *Act* states that permittees "...shall pay to the Crown, at the time and in accordance with the regulations, the fees and charges that are established by the regulations."

[10] *Waste Management Fees Regulation*, B.C. Reg. 304/87.

- permits held by the Provincial or Federal Governments;
- municipal refuse discharges; and
- domestic waste discharges on Indian Reserves.

The amount of the annual fee is determined by three factors: the type of discharge permit held (air emission, effluent or refuse discharge permit); the permittee's industrial classification; and the "capacity of the works". The industrial classification is based on Statistics Canada's system of standard industrial classifications (SIC).[11] However, the regulation makes use of its own system of industrial classifications where the SIC system was felt to be inappropriate. The regulation specifies a total of 119 industry groups of which 108 are SIC groupings and the remaining 11 are the other classifications (NC) developed for the purposes of the regulation. Table 2-1 provides a listing of the industrial classifications used and the number of permits held by each classification as of October, 1989.

For 100 of the 119 industry groups, the third factor in determining the permit fee, the "capacity of the works", is defined as the actual production or processing capacity of the works. For this group, permit fees are based on level of production and not on the quantity of wastes discharged. For example, as shown in Table 2-2, a pulp mill (SIC=2711) with a production capacity of 2,000 air dry unbleached tonnes per day would pay an annual fee of $20,000 for an air emission permit, $15,000 for an effluent permit, and $10,000 for a refuse permit. For the other 19 industry groups, the capacity of their works is defined as the maximum volume of discharges authorized by the permit or the actual discharge level, if known. However, for this latter group, the fees are based on the volume of material discharged alone, in m^3 per day or minute, and not on the strength of the contaminants contained in the discharges. Thus, the fees for this second group are not based on the total pollutant loadings (ie. volume x concentrations) authorized by the permit. For example, as shown in Table 2-2, a placer mine (NC=0006) authorized to discharge 10,000 m^3 per day of waste would pay an annual fee of $1,600 for an air emission permit, $1,200 for an effluent permit, and $800 for a refuse permit.

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[11] The classification has been done at the four digit level.

TABLE 2-1

INDUSTRY CLASSIFICATIONS AND NUMBER OF PERMITS

Industry Classifications	Permit Type		
	Air	Effluent	Refuse
SIC CODES			
0111-0113: Dairy, Cattle and Hog Farms		1	
0114: Poultry and Egg Farms		1	
0123: Furs and Skins, Ranch			
0131-0139: Field Crop Farms			
0151-0159: Fruit and Other Vegetable Farms			
0161-0169: Horticulture Specialities	1		
0211-0219: Services Incidental to Livestock and Animal Specialities	3	9	1
0311-0312: Fish Farming	1	10	
0321: Services Incidental to Fishing- Fish Hatchery		65	
0411: Logging Industry	18		123
0611-0619: Metal Mines(Except Placer Mines)	31	52	25
0621-0629: Non-Metal Mines	2	5	1
0631-0633: Coal Mines	7	16	7
0711: Crude and Natural Gas Processing	41	2	4
0811-0821: Quarry and Sand Pit Industries	16	38	
1011: Meat and Meat Products Industries	7	28	1
1012: Poultry Products	1	2	
1021: Fish Processing	2	43	1
1031: Fruit and Vegetable Canneries	1	12	1
1032: Frozen Fruit and Vegetables	3	1	
1041-1049: Dairy Products Industry		4	
1051-1053: Flour, Prepared Cereal and Feed Industries	21	4	
1081: Cane and Beet Sugar Industry		1	
1091: Tea and Coffee Industry	7		
1099: Other Food Products Industries		2	
1111: Soft Drink Industry		2	
1121: Distillery Products Industry	2	2	
1131: Brewery Products Industry	5	2	
1141: Wine Industry	1	6	
1151-1599: Rubber Products Industry	2		
1161-1699: Plastic Products	14	4	
1171: Leather Tanneries	1		
2511: Shake and Shingle Mills	41	1	5
2512: Saw and Planing Mill Products	185	24	132
2522: Softwood Veneer and Plywood	22	15	12
2541-2581: Sash, Door and Other Millwork	27		3
2591: Wood Preservation Industry	8	4	2
2592-2593: Particle Board and Wafer Board	5	2	2
2599: Other Wood Industries	2	1	
2611: Wooden Household Furniture	6		
2649: Other Office Furniture Industries	2		

TABLE 2-1 CONTINUED

Industry Classifications	Permit Type		
	Air	Effluent	Refuse
2692: Institutional Furniture and Fixture	2		
2711-2712:Pulp and Newsprint Industry	23	21	26
2713-2714: Paper and Building Board	1	1	2
2719: Other Paper Industries	3	1	
2721: Asphalt Roofing Industry	2	1	
2731-2733: Paper Box and Bag Industry	5	4	
2791-2799: Other Converted Paper Products			
2811-2849: Printing, Publishing and Allied	6		
2911-2919: Primary Steel Industries	5	2	1
2921: Steel Pipe and Tube Industry			
2941: Iron Foundries	12	2	1
2951: Primary Production of Aluminum	2	1	1
2959: Other Smelting Non-Ferrous Ind.	5	1	2
2961: Aluminum Rolling, Casting and Extrud,	3	1	
2971-2999: Copper and Copper Alloy Rolling, Casting and Extruding Industries	4	1	
3010-3099: Fabricating Metal Products	22	6	
3231-3244: Motor Vehicle Industry	1		
3251-3259: Motor Vehicle Parts and Accessories Industry	3		
3271: Ship Building and Repair	4		
3281: Boat Building and Repair	1	1	
3311-3341: Electrical and Electronic Products			
3351-3359: Communication and Other Electronic Equipment	3	1	
3371-3379: Electrical Industrial Equipment	4		
3391: Battery Industry	3		
3511-3512: Clay Products Industry	5		1
3521: Hydraulic Cement Industry	3	3	1
3541-3549: Structural Concrete Products	10	2	1
3551: Ready-Mix Concrete	81	60	
3561: Primary Glass and Glass Containers	2	1	1
3571: Abrasives Industry	1		1
3581: Lime Industry	2		
3591-3599: Other Non-Metallic Mineral Products	9	2	1
3611: Refineries	6	6	7
3612: Lubricating Oil and Grease Industry	2	2	
3699: Other Petroleum And Coal Products	74	2	
3711-3799: Chemical and Chemical Products	31	26	5
3922: Precious Metal Secondary Refining	2		
4542: Ferry Industry		8	
4544: Ship Chartering Industry			
4551: Marine Cargo Handling Industry	7	6	
4611: Natural Gas Pipeline Transport Ind.	39	2	
4612-4619: Crude Oil and Other Pipeline Ind.	6	1	
4711: Grain Elevator Industry	9		

TABLE 2-1 CONTINUED

Industry Classifications	Permit Type		
	Air	Effluent	Refuse
4791-4799: Other Storage and Warehousing		1	
4911: Electric Power Systems	18	1	
4921: Gas Distribution Systems Industry			
5011: Livestock, Wholesale			
5111: Petroleum Products, Wholesale	45	22	3
5511-5519: Motor Vehicles, Wholesale			
5521-5529: Motor Vehicle Parts and Accessories, Wholesale	1		
5613: Non-Ferrous Metals and Metal Products, Wholesale	1		
5639: Other Building Materials, Wholesale	1		
5711: Farm Machinery-Equipment and Supplies, Wholesale			
5721-5731: Other Machinery, Equipment and Supplies, Wholesale	2	7	
5911-5919: Waste Materials, Wholesale	8	1	3
5921-5929: Paper and Paper Products, Wh.	1		
6311-6399: Automotive Vehicle Industries, Sales and Services	2	23	
7511-7599: Real Estate		119	3
8111-8276: Federal or Provincial Government	1	11	3
8511-8599: Educational Service Industries		24	
8611-8679:Health and Social Service Industry	1	10	1
9111-9141: Accommodation Service Industry	3	107	12
9149: Other Recreation and Vacation Camps	1	8	2
9211-9229: Food and Beverage Service Ind.		18	
9611-9699:Amusement and Recreational Serv.	3	34	2
9721-9723: Self-Serve Laundries and Cleaners	1	39	
9941: Electric Motor Repair	4		
NC CODES			
NC01: Fruit and Vegetable Growers and Growers' Cooperatives	1	18	
NC02: Waste Disposal Operators	30	393	441
NC03: Storage Facilities for Bulk Solids	11	1	1
NC04: Storage Facilities for Bulk Liquids	5	4	
NC05: Anthracite Coal Mines	1		
NC06: Placer Mines		62	
NC07: Medical, Health and Other Laboratories	5	2	1
NC08: Other Wood Products Industries	3	1	1
NC09: Other Repair Shops		2	
NC10: Other Recycling Operations	2	6	
NC11: An Industry Not Referred to Elsewhere	5	3	3
Permits Not Classified			9
TOTAL	1,043	1,442	856

= 3341

The permit fees increase in a block rate, or stepped, fashion as shown in Table 2-2. Within a given capacity block, the fee remains constant. The table also shows that the fee for an air emission permit relative to a effluent permit relative to a refuse permit was established using a ratio of 4:3:2. At the time the permit fee regulation was drafted, these ratios were felt to be representative of the relative cost of administering the different permit types. The maximum permit fee is $24,000, for a air emission permit for a pulp mill, and the minimum fee is $50 for a refuse permit for a dozen different industry groups.

2.5 EVALUATION OF THE CURRENT FEE SYSTEM

It would be instructive at this point to see how effectively the current permit fee system can meet the four potential objectives of a discharge fee system outlined in Section One - economic efficiency, economic incentive, cost recovery, and equity.

Economic Efficiency

In order for the discharge fees to correct the economic inefficiency created by the pollutant discharges, the fees would have to be set to include all external costs. The costs incorporated should include not only government regulatory costs but also the costs of any environmental damages, the costs of any human health injuries, plus the collection of a resource rent for the use of the natural assimilative capacity of the receiving environment. As the current fee system is collecting only a portion of the government's regulatory costs, and none of the other costs, the fees can be said to be making only a small contribution towards economic efficiency.

Economic Incentive

For the majority of the industries whose "capacity" is based on their level of production, the fees provide no incentive whatsoever to reduce their discharges as the fees are in no way linked to the quantity and quality of their discharges. For the 19 industry groups whose capacity is based on their maximum permitted volume of discharges, the fees provide

TABLE 2-2

EXAMPLES OF WASTE MANAGEMENT PERMIT FEES FOR INDUSTRY GROUPINGS

SIC = 2711 to 2712: Pulp and Newsprint Industry

Capacity	Permit Type		
ADU Tonnes/Day	Air	Effluent	Refuse
0-499	$4,000	$3,000	$2,000
500-999	$8,000	$6,000	$4,000
1,000-1,499	$12,000	$9,000	$6,000
1,500-1,999	$16,000	$12,000	$8,000
2,000-2,499	$20,000	$15,000	$10,000
2,500+	$24,000	$18,000	$12,000

SIC = 2512: Saw and Planing Mill Products Industry

Capacity	Permit Type		
Mfbm/Day	Air	Effluent	Refuse
0-49	$200	$150	$100
50-99	$400	$300	$200
100-199	$800	$600	$400
200-299	$1,600	$1,200	$800
300-399	$2,400	$1,800	$1,200
400-499	$3,200	$2,400	$1,600
500-599	$4,000	$3,000	$2,000
600-699	$4,800	$3,600	$2,400
700-799	$5,600	$4,200	$2,800
800-899	$6,400	$4,800	$3,200
900-999	$7,200	$5,400	$3,600
1,000+	$8,000	$6,000	$4,000

NC = 0006: Placer Mines

Capacity	Permit Type		
m^3/Day Waste	Air	Effluent	Refuse
0-99	$400	$300	$200
100-999	$800	$600	$400
1,000-9,999	$1,200	$900	$600
10,000-99,999	$1,600	$1,200	$800
100,000+	$2,000	$1,500	$1,000

Source: *Waste Management Fees Regulation*, B.C. Reg. 304/87 .
ADU - air dry unbleached.
Mfbm - thousand board feet measure.

only a limited incentive to reduce their discharges. First, as shown in Table 2-2 for placer mines, the fees increase in a block rate fashion so there is no incentive to reduce discharges within a given block level. Second, as the block rates increase, the average fee for a unit volume of waste discharged declines. For example, Table 2-3 show the total and average fee for an effluent permit for a waste disposal operation (NC=0002). While the total fee increases between blocks, the average fee begins to decline then starts to rise and finally drops off quickly; thus, there is little incentive for large dischargers to reduce their volume of discharges. In addition, because the fees for this latter group are based only on the volume of their discharges and not on the concentration of pollutants within the discharges, the current system, rather perversely, provides an incentive for a firm to reduce the volume of their discharges by increasing the concentration of their discharges (provided that this was permissable under their permit conditions).

Cost Recovery

The current fee system is expected to recover less than 15 percent of the permit system's total regulatory costs in the 1990/91 fiscal year. Thus, the current fee system is serving only as a partial cost recovery mechanism.

Equity

The equity of the current system will be examined by comparing the treatment of discharges within industry groups and between industry groups. Table 2-4 lists the average fee per unit of capacity for the pulp and newsprint industry. While Table 2-2 shows that the block rates for the fees increase as production increases, Table 2-4 shows that the average fee per unit of production falls off very quickly. This declining average fee per unit of capacity can only be viewed as being equitable if the quantity of pollutants discharged per unit of capacity also falls as total capacity increases. It is not obvious that this condition can be said to exist. The fee levels between industry groups were set rather arbitrarily but attempted to reflect an intuitive understanding of the relative costs of administering a permit between industry groups. Nevertheless, the production processes of industries will change over time which will necessitate the revision of the relative inter-industry fee levels from time to time.

TABLE 2-3

TOTAL AND AVERAGE FEES FOR AN EFFLUENT PERMIT FOR A WASTE DISPOSAL OPERATION (NC = 0002)

Capacity (m³ of waste/day)	Total Fees ($)	Average Fee ($/m³/day)
1	75	75.00
50	150	3.00
100	300	3.00
150	450	3.00
200	900	4.50
250	1,800	7.20
500	2,700	5.40
1,000	3,600	3.60
1,500	4,500	3.00
2,000	5,400	2.70
5,000	6,300	1.26
10,000	7,200	0.72
15,000	8,100	0.54
20,000	9,000	0.45
25,000	9,900	0.40
30,000	10,800	0.36
50,000	11,700	0.23
100,000	12,600	0.13

TABLE 2-4

AVERAGE FEES PER UNIT OF CAPACITY FOR THE PULP AND NEWSPRINT INDUSTRY

Capacity		Permit Type	
ADU Tonnes/Day	Air	Effluent	Refuse
1	$4,000.00	$3,000.00	$2,000.00
500	$16.00	$12.00	$8.00
1,000	$12.00	$9.00	$6.00
1,500	$10.67	$8.00	$5.33
2,000	$10.00	$7.50	$5.00
2,500	$9.60	$7.20	$4.80

SECTION THREE

EXAMPLES OF WASTEWATER DISCHARGE FEE SYSTEMS

3.1 INTRODUCTION

This section reviews examples of wastewater discharge fee systems which have been employed as part of a nation's water quality management strategy.[1] The fee systems used by three European countries, the Netherlands, France, and West Germany, have been chosen for use as case studies. Each case study begins with a description of the countries original water pollution problems, then moves on to discuss the water management strategy chosen to solve the problem and how the discharge fees fit into the overall management strategy. Each case study ends with a description of the results achieved by the water management strategy and a few comments on the discharge fee system chosen.

3.2 THE NETHERLANDS

Introduction

The Netherlands has a population of over 14 million people living in an area of only 37,000 km^2, an area approximately the size of Vancouver Island.[2] It has one of the highest population densities of any country in the world - 415 people/km^2. The waste water effluent produced by such a large population together with its highly industrialized economy are enormous. By the end of the 1960s, the Netherlands found that they were discharging several times the amount of wastewater that the country's river and lake systems could naturally regenerate and this was leading to the destruction of aquatic ecosystems (Bongaerts and Kraemer, 1989). By 1969, the industrial and domestic discharges of oxygen-consuming material had reached a level equivalent to the discharges of a population of 40 million people (Meijer, 1983).

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[1] The terms wastewater and effluent have been used interchangeably throughout the remainder of this report.

[2] The review of the Dutch system of water management is based on the works of de Groot (1972), Scheltinga (1977), OECD (1980a), Meijer (1983), Bressers, (1983), Effluent and Water Treatment Journal (1984b), and Bongaerts and Kraemer (1989). Reader requiring more detailed information should consult these references.

Effluent Control Strategy

To combat their effluent problems, the Netherlands implemented an effluent control strategy, the legal basis of which came from the *Surface Water Pollution Control Act*, which came into force on December 1, 1970. The major emphasis of the Netherlands' control strategy has been the elimination of organic (ie. oxygen depleting) pollutants, although in recent years, due to the success of the control strategy, the emphasis has been switching to other pollutants (ie. pesticides and heavy metals). The Netherlands' effluent control strategy has been built on the following three principles:

- the decentralization of water management responsibilities;
- the requirement for a permit to authorize the discharge of any effluent to surface waters; and
- the imposition of effluent discharge fees to recover water management costs in accordance with the polluter pay principle.

The Netherlands has decentralized its water management functions by instituting a three-level hierarchy of responsibility for water management. The three levels are the state, the province and the local water board. The national government has responsibility for the management of the countries large international rivers - the Rhine, the Meuse and the Schelt - and the countries main canals, large lakes, estuaries and its territorial maritime waters. The management of these so-called "state waters" has been assigned to the Ministry of Public Works. The provinces have been given responsibility for the management of all other water bodies and resources. However, the provinces can delegate these responsibilities to local water boards and 8 of the 11 provinces have done so. After a 1981 reorganization of water management agencies, there were 27 such local boards in existence (Effluent and Water Treatment Journal, 1984b).

The *Surface Water Pollution Control Act* requires that any person discharging waste waters directly to surface waters must first obtain a permit to do so. The permit conditions specify the quantity and quality of the effluent which can be discharged into surface waters. In addition, the permits require that any contaminants contained on a list of highly hazardous substances be eliminated from the effluent or, if they cannot be totally eliminated, that the "best technical means" be used to reduce the discharges of these contaminants.[3] Best technical means is defined as "technology which has been proven in practice at least once and brings about a maximum technically feasible pollutant reduction" (Meijer, 1983). Other contaminants, not included on the so-called "black list", must be treated with the "best practical means" which are "common and approved treatment systems that give the best pollutant reduction at a cost that can be reasonably borne by the average profitable industry" (Meijer, 1983).

Effluent Discharge Fees

The *Surface Water Pollution Control Act* also requires that any person discharging effluent to surface waters pay a levy based on the effluent's pollutant load. The *Act* authorizes the levy to be imposed on both the quantity of oxygen-consuming matter and inorganic matter contained in the effluent. Currently, only the levy on oxygen-consuming matter is collected nation-wide. However, most local water boards have also imposed a fee on heavy metal discharges (Meijer, 1983). In calculating the levy, the pollutant load is first reduced to a common unit of measurement - the "population equivalent".[4] For organic pollutants, the population equivalent, or p.e., is defined as 180 grams of oxygen demand which is measured on a combined basis of chemical oxygen demand (COD) and nitrogen (N) (Scheltinga, 1977).[5] The population equivalent unit is based on the assumption that, on average, one person produces 180 grams of oxygen demand per day, thus the name "population equivalent". The formula for converting the organic components of industrial effluent into population equivalents is:

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[3] On May 4, 1976, the European Economic Community promulgated the Directive on pollution caused by certain dangerous substances discharged into the aquatic environment. This directive contained the list of hazardous contaminants which was incorporated by the Netherlands into its water management strategy.

[4] Some works refer to the pollutant unit of measure by the alternative title of "inhabitant equivalents". For example, Bressers (1983) and Bongaerts and Kraemer (1989) use this terminology.

$$p.e. = \frac{Q^*(COD + 4.57N)}{180}$$

where Q = the quantity of waste water discharged measured in m^3,
COD = the chemical oxygen demand measured in mg/m^3, and
N = the nitrogen loading measured in mg/m^3.

In those water management areas which impose a levy on inorganic materials, 1 kilogram per year of copper, zinc, chromium, silver, arsenic, lead, or nickel discharged is taken to be equal to 1 p.e. as is 100 grams per year of cadmium or mercury discharged (Meijer, 1983). This means that cadmium and mercury discharges will be charged ten times more for each kilogram discharged than will discharges of the other metals. Thus, by varying the relative weights assigned to each pollutant parameter, the fee system can provide greater incentives to reduce the discharges of more harmful materials.

The Netherlands has taken a very pragmatic approach to the problem of measuring the volume of effluent discharged by each permittee in order to keep the administration of the effluent fee system as simple as possible. Household discharges are assumed to be equal to 3 to 3.5 population equivalents. Other permits discharging less than 10 p.e. are charged the household rate. For permits of less than 1000 p.e., where the costs of measurement may be high relative to the pollutant loadings, a system of coefficients is used to estimate their discharges. These coefficients would be in terms of estimated discharges per unit of production, per employee or per unit of potable water consumed. For all other discharges, the calculation is done by actual measurement of the volume and by sampling the flow of the effluent discharged. For this latter group, the measurements must be made daily unless the permittee can prove that an equally reliable result can be achieved by other means.

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[5] The Netherlands has chosen to use the COD value over the more common BOD (biological oxygen demand) value in order to avoid analytical problems especially those associated with the measurement of industrial effluent (Scheltinga, 1977).

The actual level of the discharge fees is set separately by each water management area. The fee level is fixed annually by the local water board so as to cover its total cost of water management. This would include the board's capital, operating and administrative costs. The fee per p.e. is calculated by dividing the board's annual budget by the total number of permitted p.e. discharges. Thus, the fee is set at the board's average unit cost of management. Table 3-1 provides examples of the fees charged by the state, two provinces and five water boards. As shown, the fees vary considerably from water board to water board, reflecting the differing costs of treatment faced by the various water boards.

The fees collected by the state for discharges to "state waters" are determined separately from the local water boards. The state's fees are typically much lower than the local water boards' fees because the state does not operate any waste water treatment plants nor do they recover any of the Ministry of Public Works' administrative costs (Meijer, 1983). Instead, the fees are set and used to subsidize the construction of municipal and industrial waste treatment facilities.

The level of the fees have increased quite dramatically since they were first introduced. For example, the fee for discharges to state controlled fresh waters rose from 2 guilders per p.e. in 1971, to 26.5 guilders per p.e. in 1983 (Effluent and Water Treatment Journal, 1984b). For discharges to marine state waters, the fee increased from 2 guilders per p.e. in 1973, to 20.5 guilders in 1983. Table 3-1 also shows the increases in fees for local water boards for the period 1976-82.

The Netherlands' effluent fee system has generated considerable revenue over the years for the funding of water management. The total amount collected by all water management agencies in the Netherlands was, measured in U.S. dollars, approximately $20 million in 1971, $140 million in 1979, and $300 million in 1980 (Bressers, 1983).

Results of the Control Strategy

The results achieved by the Netherlands effluent control strategy have been most impressive. Table 3-2 shows the effect of the control strategy on the discharge of oxygen-consuming wastes. The first point to note is that industrial discharges have decreased by over 70% from 33.0 million p.e. in 1969, to only a forecast 9.7 p.e. in 1985. The reduction in industrial discharges is due to increased in-plant treatment of wastes and the improved housekeeping measures undertaken by firms in order to comply with their discharge permits and to reduce their effluent fee payments. At the same time, the treatment of waste waters at public treatment plants has increased by over 350%, from 5.5 million p.e. in 1969, to a forecast 19.5 million p.e. in 1985. The overall result is that the Netherlands will have achieved a forecast 89% reduction in their discharges of oxygen-consuming discharges over 15 years.

The Netherlands has not yet put the emphasis on inorganic discharges that it originally placed on organic discharges, but this is changing as noted above. Nevertheless, the Netherlands has made good progress in reducing its discharges of inorganic material as show in Table 3-3. The Netherlands internal discharges of these inorganic pollutants are now less than the inflow of these pollutants from countries upstream of the Netherlands on the Rhine and Meuse Rivers which includes West Germany, France, Belgium, Luxembourg and Switzerland (Meijer, 1983).

Comments

The primary function of the effluent fees in the Netherlands is to serve as a cost-recovery mechanism. While the ability of the fees to act as an economic incentive to promote waste abatement is recognized, it is a secondary consideration in the setting of the fee rates. Nevertheless, the fees have been credited by many reviewers as being a major reason for the increasing abatement measures undertaken by industry (see Bressers, 1983; Bongaerts and Kraemer, 1989; and Meijer, 1983). For example, the Chief Inspector, Public Health and Environmental Protection in the Netherlands states:

As to the industrial waste water production a remarkable decrease since 1965 can be observed and a further decrease is expected. A small portion of this reduction, some 10-20 per cent, is attributable to end-of-pipe treatment. The main part, however, is due to internal measurements, improved technology and "good housekeeping". Industry is forced to take these types of actions by the permits issued by the water quality authorities, but the pressure of a steadily increasing taxation level is a far more effective means, as experience has shown (Scheltinga, 1977).

TABLE 3-1

WASTEWATER DISCHARGE FEES IN THE NETHERLANDS, 1976-82

(Guilders per population equivalent)

Jurisdiction	1976	1979	1980	1981	1982	1982 (Can. $)
STATE WATERS						
Fresh Water	15.00	21.75	23.50	24.50	25.50	11.79
Salt Water	9.00	15.75	17.70	18.50	19.50	9.01
PROVINCES						
Gronigen	19.50	31.00	39.00	45.00	50.00	23.11
Limburg	23.00	33.84	37.44	41.16	44.52	20.58
WATER AUTHORITIES						
Regge en Dinkel	19.44	28.80	32.64	36.24	39.84	18.41
Rijnland	23.50	32.00	36.00	44.50	49.60	22.93
Dommel	18.00	28.08	30.48	31.92	34.80	16.08
Unitwatereude Sluizen	27.65	44.35	48.00	54.00	61.00	28.19
Hollandse Eilanden en Waarden	24.65	40.90	43.83	49.75	64.00	29.58

Source: Meijer, 1983.

TABLE 3-2

THE EFFECT OF NETHERLANDS' POLLUTION CONTROL SYSTEM ON WASTEWATER DISCHARGES

(millions of population equivalents)

	1969	1975	1980	1985 (Forecast)
Discharges*:				
Domestic	12.5	13.3	13.8	14.2
Industrial	33.0	19.7	14.3	9.7
TOTAL:	45.5	33.0	28.1	23.9
Discharges Eliminated in Public Treatment Plants	5.5	8.7	12.8	19.5
Total Load of Oxygen Consuming Discharges to Surface Waters	40.0	24.3	15.3	4.4

* Includes Direct Discharges to Surface Waters and Discharges to Public Sewer Systems.

Source: Meijer, 1983.

TABLE 3-3

REDUCTION OF HEAVY METAL LOADS INTO SURFACE WATERS IN THE NETHERLANDS

(tonnes per year)

Metal	1975	1980	1985 (Forecast)
Mercury	4.6	0.7	0.4
Cadmium	29	15	10
Zinc	1500	900	300
Copper	150	120	90
Nickel	80	45	40
Chromium	350	110	100
Lead	300	200	50
Phosphate (asP)	29000	14000	12000
Mineral Oil	13000	8000	3500

Source: Meijer, 1983.

3.3 FRANCE

Introduction

France has a population of over 54 million, which is approximately twice that of Canada, living in a land area just over half the size of British Columbia.[6] Still, France is one of the least densely populated and one of the most agricultural countries within the European Economic Community (EEC). France's post-World War II industrial policy has been aimed at increasing its industrial capacity and its level of urbanization. Its success in achieving these goals, together with an expanding population base, has put increasing pressures on the environment, particularly its water resources.

The Organization of Water Management

Increasing concerns over the growth of water pollution during the early 1960s led to the passage of the *Act of December 16, 1964 (No. 64-1245) on the Management and Allocation of Water Resources and the Abatement of Water Pollution.*[7] The *Act* organized water management in France into six water basin authorities which were based on the country's major hydrographic (river) basins: Artois-Picardy, Rhine-Meuse, Seine-Normandy, Loire-Brittany, Adour-Garonne, and Rhone-Mediterranean-Corse. Within each basin, water management policies and plans are developed and implemented by two organizations - a Basin Committee[8] and a Basin Financial Agency[9].

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[6] The review of France's water management system was based on the works of Fiessinger and Teniere-Buchot (1976), Reese (1983), Harrison and Sewell (1980), Effluent and Water Treatment Journal (1984a), OECD (1980a), Bower (1983) and Bongaerts and Kraemer (1989).

[7] "Loi no. 64-1245 relative au régime et à la répartition des eaux à la lutte contre leur pollution du 16 décembre 1964".

[8] "Comités de Bassin".

[9] "Agence Financière de Bassin".

The Basin Committee acts as miniature "water parliament" which approves the basin's program plan for the development of water resources and pollution control. However, the program plans must be developed within an overall set of nationally determined objectives. The Committees are made up of an equal number of representatives from each of three groups:

- National Government Representatives Delegates are appointed from the Ministries of Agriculture, Public Works, Industry, Interior, Public Health, Finance, and Environment.
- Local Government Representatives Delegates are elected by county councils.
- Water User Representatives Delegates are appointed by the various user group organizations, ie. farmers, fishermen, water supply companies, industries, tourist agencies, etc.

The Basin Financial Agency is the public administrative organization which develops, for the approval of the Basin Committee, the basin's program plan and undertakes the program's implementation. These multi-year plans, usually of four or five years duration, detail the funding of water resource development projects (such as dams, water distribution systems or the recharge of ground waters) and, more importantly, the subsidization of municipal and industrial pollution control measures. The Agencies do not undertake the construction and operation of the projects themselves but, rather, they act as a "water bank" which provides the required financial aid (Fiessinger and Teniere-Buchot, 1976).

Neither the Basin Committee or the Financial Agency are regulatory bodies. For example, they are not empowered to issue pollution discharge permits nor to set water quality objectives. Rather, these responsibilities have remained with France's Ministry of Environment. The requirement for and issuing of waste discharge permits is detailed in the *Act (No. 76-663) on Installations Classified for Purposes of Environmental Protection.*[10]

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[10] "La loi no. 76-663 du 19 juillet 1976 relative aux installations classées pour la protection de l'environment". The law came into effect by decree on January 1, 1977.

Discharge Fee System

The Basin Financial Agencies are financially autonomous of the national government. The agencies finance their operation through the use of water withdrawal and water pollution fees. In 1976, the six agencies collected approximately 1 billion francs ($207 million) from the fees, two-thirds of which was derived from the pollution fees and the remaining one-third from the water withdrawal fees (Fiessinger and Teniere-Buchot, 1976).

The pollution fees were originally based on the suspended solids (SS) and oxidizable matter (OM) contained within the effluent. Oxidizable matter is measured using a weighted average of the chemical oxygen demand (COD) and the five-day biological demand (BOD), using the following formula:

$$OM = \frac{COD + 2(BOD)}{3}.$$

Soluble salts (SALT) was added to the list of pollutant fees in 1972, and toxic substances (TS) in 1974 (Fiesinger and Teniere-Buchot, 1976). The measure of soluble salts is based on the conductivity of the salts in the water. Toxic substances are measured by their weight times a toxicity factor. The toxicity factor is the number of equitox per cubic meter.[11] Nitrogen (N) and phosphorous (P) were added later to the pollutant fee list and are measured by weight. The base fees charged by the various river basins for each pollutant type are listed in Table 3-4. The table shows a great deal of variation across river basins in the fee level set which reflects the concern each river basin has about the various pollutants and their treatment costs for each pollutant. The manner in which river basins set the fee for each pollutant is discussed in more detail below.

Within a river basin, the base fees for each pollutant type vary depending on the area in the river basin into which the effluent is discharged. This intra-basin variation in the base fees is accomplished by applying a zone coefficient to the base fees; the zone coefficients used in one river basin are presented in Table 3-5. The purpose of the coefficients is to make the fee system responsive to the environmental needs of specific areas and to promote industrial development in areas compatible with water management needs (OECD, 1980).

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[11] "An equitox equals a 50 percent death rate among a population of daphnia issued by parthenogenesis from the same individual. Daphnia is a minute freshwater crustacean related to the water flea." (Fiessinger and Teniere-Buchot, 1976).

The formula for determining an industry's total effluent charge is:

$$IC = \sum_{i=1}^{n} F_i \times Q_i \times ZONE$$

where IC = the industries total charge,

F_i = the fee per unit of pollutant type i discharged,

Q_i = the total quantity of pollutant type i discharged (volume of effluent discharged times the concentration of the contaminant),

ZONE = the zonal coefficient applicable to the area into which the effluent is discharged, and

n = the number of pollutant types discharged by the firm.

In order to avoid economic disruption, an upper limit on the effluent fees has been established at 2.5 percent of the value added by a firm in its production process (Reese, 1983).

For municipal discharges, the fees payable are based on the number of urban population equivalents discharging into the municipal sewage system.[12] The number of population equivalents is, in turn, based on the community's total permanent population plus 40 percent of the community's seasonal population (Harrison and Sewell, 1980). Because the amount of pollution discharged by a community does not vary in direct proportion to the size of the community, a community size coefficient is applied to the population figure to determine the number of population equivalents (OECD, 1980). The coefficients used are listed in Table 3-6. To this adjusted number of population equivalents, the fee per p.e. is applied, times the zonal coefficients, described above, to yield the community's total charge. The formula for the municipal charge is:

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[12] It is assumed that an urban population equivalent discharges, on average, 147 grams per day of oxidizable matter (OECD, 1980a).

$$MC = Fpe \times (Ppop + 0.4 \times Spop) \times SIZE \times ZONE$$

where MC = total municipal charge,
Fpe = fee per population equivalent,
Ppop = the community's permanent population,
Spop = the community's seasonal population,
SIZE = the community size coefficient, and
ZONE = the zonal coefficient.

The fee for each pollutant type is determined separately by each river basin and is set to recover the agency's expected costs over the next year. First, the agency determines its financial requirements to meet its program objectives over the next year. Next, the agency estimates the total quantity of pollutants which are expected to be discharged, adjusted by the zonal coefficients and community size coefficients described above. The total financial requirements attributable to each pollutant are divided by the estimated total quantity of each pollutant type to yield the unit fee for each pollutant.

As was the case in the Netherlands, the discharge fees in France have been increasing in real value (ie. net of inflation) over time. For example, Table 3-7 shows the increase in discharge fees for population equivalents in the Seine-Normandy River Basin for 1969-1980. During that period, the fees have increased by over 1,000 percent.

Results

Prior to 1968, France had a total of 2,500 sewage treatment plants in operation but, between 1968-73, a further 2,000 plants were constructed (Fiessinger and Teniere-Buchot, 1976). The French Government claimed that, by 1976, water pollution had stopped increasing and had started to decline by an average of 5 percent per year (Reese, 1983). By 1980, the country still had a long way to go as France had sufficient treatment capacity to handle 30 million population equivalents of wastewater but was producing wastewater equal to a total of 67 million population equivalents (Reese, 1983).[13]

Comments

The primary purpose of the discharge fees in France is to serve as a cost-recovery mechanism. The economic incentive effect of the fees is recognized but it is a secondary consideration in the setting of the fees. Currently, the discharge fees in France are estimated to be only one-third the rate necessary to achieve the full economic incentive value (OECD, 1980a).

After complaints from municipalities about the payment of the fees, the system was changed so that municipalities were not directly billed for the fees. Instead, the fees for dischargers connected to municipal sewage systems are paid by a surcharge on the discharger's water bill, based on the quantity of water consumed. While in many cases this can be a suitable system, it does disadvantage businesses who consume large quantities of water without causing a proportional increase in effluent discharges.

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[13] The 67 million population equivalents comes from the population of 53 million and industrial wastewater equal to 14 million population equivalents (Reese, 1983).

TABLE 3-4

EFFLUENT CHARGES OF FRENCH RIVER BASIN AGENCIES, 1985

(French Francs per Kilogram per Day)

River Basin Agency	Suspended Solids SS	Oxidizable Matter OM	Toxic Substances* TS	Nitrates N	Phosphates P	Soluble Salts SALT
Adour-Garonne	58.78	91.01	1,395	71.80	20.32	----
Artois-Picardie	56.30	112.60	1,750	17.30	----	----
Loire-Bretagne	89.00	106.50	2,019	78.00	255.00	----
Rhin-Meuse	57.87	115.74	1,763	57.87	----	144.00**
Rhône-Mediterranée-Corse	62.20	186.60	1,960	----	811.00	----
Seine-Normandie	78.43	156.86	1,671	128.00	----	1,603.00***

* per kilogram equitox per day

** per Mho per day

*** per (Mho/cm) x m^2 per day

Source: Bongaerts and Kraemer, 1989.

TABLE 3-5

AREA MULTIPLIERS USED IN THE SEINE-NORMANDY BASIN FOR ADJUSTING EFFLUENT CHARGE RATES

Areas	Suspended Solids	Oxidizable Matter	Inhibiting Substances
1			
- Upstream, low density of population and industrialisation	1.5	1.5	1
- Discharges by infiltration	1.5	1.5	1.5
- Coastal shellfish-breeding areas	1.5	1.5	1.5
2			
- Inland waters, middle reaches (average density)	1.2	1.2	1
- Discharges by infiltration	1.2	1.2	1.5
- Bathing area, discharge into the estuary zone	1.5	1.2	1.5
- Bathing area, discharge offshore beyond the estuary zone	1.2	1	1.5
3			
- Lower reaches and estuary (reference base)	1	1	1
- Discharges by infiltration	1	1	1.5

Source: OECD, 1980a.

TABLE 3-6

COMMUNITY SIZE COEFFICIENTS FOR THE CALCULATION OF DISCHARGE FEE PAYMENTS

Class	Population	Coefficient
I	500	0.50
II	501 - 2,000	0.75
III	2,001 - 10,000	1.00
IV	10,001 - 50,000	1.10
V	50,000 +	1.20
VI	Paris	1.40
VII	Communities with no piped water	0.00

Source: Harrison and Sewell, 1980.

TABLE 3-7

INCREASES IN DISCHARGE FEES FOR POPULATION EQUIVALENTS IN THE SEINE-NORMANDY RIVER BASIN, 1969-1980

(fee per population equivalent)

Year	Francs	$*
1969	1.12	0.22
1970	1.69	0.32
1971	2.25	0.41
1972	3.75	0.74
1973	4.41	1.00
1974	4.41	0.90
1975	4.41	1.05
1976	7.75	1.60
1977	8.25	1.79
1978	10.00	2.54
1979	11.55	3.18
1980	11.55	3.20

Source: OECD, 1980a.

*Calculated using the yearly average exchange rate as published by the Bank of Canada.

3.4 WEST GERMANY

Introduction

The rapid urban and industrial growth achieved by West Germany in the post-World War II era was considered by many to be an "economic miracle".[14] However, this miracle has come at the cost of severe degradation of the country's water resources. For example, the Rhine River was twenty times more contaminated in the early 1970s as it was in 1949, with some of its tributaries being considered biologically dead (Reese, 1983). In addition to the internal pressures, there were also external pressures being brought on West Germany by the downstream countries of the Netherlands and Switzerland to clean up shared water bodies, such as the Rhine and Lake Constance (Brown and Johnson, 1984).

Before describing West Germany's new approach to water quality management, a brief review of their system of government is needed. West Germany is a federal republic in which the eleven Länder (states) are, under the 1949 Basic Law (constitution), the constitutional equals of the federal government (Bund).[15] The legislative branch of the federal government is composed of two houses; the lower house of parliament (Bundestag) is elected by popular vote while the upper house (Bunderat) is composed of the appointed representatives of the Länder. The lower house enacts federal legislation while the upper house, as the Länders' representatives, serves primarily in an advisory role, although they do have veto power over many legislative and executive decisions (Reese, 1983). Under the 1949 constitution, the federal government was given exclusive jurisdiction over specified areas, such as national defence and foreign affairs, concurrent jurisdiction with the Länder over other areas, and only broad "framework" jurisdiction over other areas. In this latter category falls the jurisdiction over water quality management. This means that while the federal government may set national goals, objectives and requirements, the actual administration and enforcement of water management is the sole responsibility of the Länder.

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[14] The review of West Germany's water quality management system was based on the works of Leroff (1977), Hornef and Kanowski (1981), Brown and Johnson (1984), Reese (1983), Effluent and Water Treatment Journal (1984c), and Bongaerts and Kraemer (1989). Readers requiring more detail on the German system should consult these references.

[15] The eleven Länder includes three city states - Berlin, Bremen and Hamburg.

Water Management System

The federal framework legislation on which the West German water management system is based is contained in two acts passed in 1976: the fourth amendment to the *Federal Water Act*[16], and the *Wastewater Charges Act*.[17] The *Wastewater Charges Act* established a national system of fees for wastewater discharges which is discussed in detail below. The main provisions of the *Federal Water Act* include:

- the continuation of the wastewater discharge permit system established under the original 1957 version of the *Act*;
- the establishment of the conditions under which a discharge permit may be granted; and
- the granting to the federal government the right to:

  * establish uniform discharge standards for major pollutants;
  * determine the level of technology which a municipality or industry must employ to reduce their waste discharges; and
  * establish minimum national water quality goals for receiving waters.

Within this broad national framework, the Länder have the responsibility for the detailed implementation of water management programs within their boundaries. This includes the issuing and enforcement of discharge permits and the collection of the discharge fees. In addition, the Länder may, if they wish, establish stricter discharge standards than the minimum federal standards.

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[16] Act of the Regulation on Matters Relating to Water (Federal Water Act), *Wasserhaushaltsgesetz*, Federal Law Gazette I, p. 3017, 16 October 1976.

[17] Act Pertaining to Charges Levied for Discharging Wastewater into Waters (Wastewater Charges Act), *Abwasserabgabengesetz*, Federal Law Gazette I, p. 2721, 13 September 1976.

Wastewater Discharge Fees

Although the *Wastewater Charges Act* came into effect on January 1, 1978, the liability to pay the discharge fees did not come into effect until January 1, 1981. The fees are based on the quantity of wastewater discharged and on the wastewater's "noxiousness" (quality). The determination of the noxiousness of the effluent is based on the quantity of six pollutants contained in the effluent: settleable solids, oxidizable substances, mercury, cadmium, and toxicity to fish. Table 3-8 presents the method by which the number of units of noxiousness for each pollutant are calculated.

The quantity of pollutants on which the charge is assessed is not based on actual measurements of the wastes discharged by a permittee but rather on the quantity of wastes the discharge permit authorizes to be discharged. The discharge permits specify the mean values of water quality to be maintained and the maximum values which cannot be exceeded. The fee payable is based on the mean values or at least 50% of the maximum value permitted. Alternatively, the *Act* allows for a permittee to base his payments on the measured quantity of discharges. However, the permittee must undertake the measurements and his system of measurement must be approved by the water management authorities.

The discharge fees were implemented on January 1, 1981, at the rate of 12 DM ($6.38) per unit of noxiousness discharged. As shown in Table 3-9, the discharge fee was scheduled to rise every year over the following five years until the maximum rate of 40 DM ($21.27) per unit of noxiousness was reached. The maximum rate was established:

> "to approximate the average purification cost of an average-size wastewater treatment plant designed for full biological purification. Such a plant has at least 90 percent efficiency, and the average cost includes both operating costs and amortized capital costs." [18]

However, as this rate was set in 1976, inflation will have eroded its real value unless suitable indexing has taken place.

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[18] Reese, 1983, p.154.

The *Wastewater Charges Act* allows for the fees payable by a permittee to be reduced by 50 percent if the discharges are in compliance with the national minimum standards for quantity and noxiousness.[19] If the Länder have set stricter minimum requirements, the permittee's discharges must meet the Länder's minimum standards in order to qualify for the 50 percent reduction in fees. The *Act* also contains a hardship clause that allows the federal government to exempt parties liable to the fees from payment "in order to avert any significant detrimental economic developments".[20] However, the exemption would only be temporary and would not extend past December 31, 1989.

The discharge fees levied under the *Act* are collected by the Länder which can only use the funds for "specific purposes connected with measures for maintaining or improving water quality".[21] Under the *Act*, the Länders' eligible costs include:

- administrative costs associated with the enforcement of the *Act*;
- the capital costs of wastewater treatment plants, rain water retention and treatment facilities, holding canals and main connecting sewers which permit the erection of joint sewage facilities, and sewage sludge disposal facilities;
- water quality measures taken within a water body such as oxygen enrichment;
- water quality research and development; and
- the training of water treatment and other facility operating staff.

In 1981, the discharge fees raised approximately 350 DM million ($186 million) for use by the Länder (Brown and Johnson, 1984).

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[19] Article 9 (5). The reduction in fees does not apply to fees payable for runoff of rainfall from urban areas.

[20] Article 9 (6).

[21] Article 13 (1).

Results

As the West German system is the newest of the effluent discharge systems put into place, there is little available in the way of published results. However, Brown and Johnson (1984), in a review of the West German effluent fee system, make the following observations:

- in 1981, more than half of the permittees met the minimum national discharge standards and thus qualified for the 50 percent reduction in discharge fees; and
- a survey of municipal governments showed that just over one-third of the respondents cited the discharge fees as the main reason for undertaking more extensive waste treatment measures while another 20 percent stated that the fees caused them to accelerate their construction plans.[22]

Comments

When originally established the fees were based on promoting economic efficiency by setting the fees equal to the marginal abatement cost of the average waste discharger for a set level of treatment. The fees also act as a cost recovery mechanism but this is a secondary consideration in West Germany as opposed to the Netherlands and France where it was the primary purpose of the fees.

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[22] H. Hoffman and D. Ewringmann, Auswirkungen des Abwasserabgabengesetzes auf Investitionsplanung und Abwicklung in Unternehmen, Gemeinden und Abwasserverbänden (1977) (Effects of the Effluent Charge Law on Investment Planning and Arrangements in Firms, Municipalities and Effluent Associations), as cited by Brown and Johnson (1984).

TABLE 3-8

WEST GERMANY'S METHOD OF WEIGHTING POLLUTANT TYPES

Pollutants	Units of Noxiousness/Pollutant Measuring Unit	
	Pollutant Measuring Unit	Units of Noxiousness
- Settleable Solids Containing @ least 10% Organic Matter	1 cubic meter (m^3)	= 1.0
- Settleable Solids Containing Less Than 10% Organic Matter	1 cubic meter (m^3)	= 0.1
- Oxidizable Substances Expressed as Chemical Oxygen Demand	100 kilograms (kg)	= 2.2
- Mercury and its Compounds	100 grams (g)	= 5.0
- Cadmium and its Compounds	100 grams (g)	= 1.0
-Toxicity for Fish	1,000 cubic meters (m^3) of wastewater	= 0.3GF*

* GF represents the dilution factor at which the waste water would lose its toxic effects on fish. When GF = 2, the figure applied shall be 0.

Source: Federal Republic of Germany, *Wastewater Charges Act*, 1976.

TABLE 3-9

WEST GERMAN NATIONAL EFFLUENT TAX RATES, 1981-1986

YEAR*	Wastewater Tax Rate per Unit of Noxiousness	
	(DM)	($)**
1981	12	6.38
1982	18	9.15
1983	24	11.60
1984	30	13.69
1985	36	16.84
1986	40	25.70

* Effective on January 1 of each year.

* * Calculated using the yearly average exchange rate as published by the Bank of Canada.

Source: Federal Republic of Germany, *Wastewater Charges Act*, 1976.

SECTION FOUR

EXAMPLES OF AIR EMISSION FEE SYSTEMS

4.1 INTRODUCTION

The application of discharge fees to the problems associated with air pollution emissions is by no means as common as is the case with wastewater effluent. Indeed, this section will review the air emission fee systems of only two countries, Norway and Japan, plus the system used by California's South Coast Air Quality Management District. Air emission fees are less common for several reasons. First, emissions are difficult and expensive to measure which means that finding the basis for levying a fee may be difficult.[1] Second, defining the area affected by air pollution is more difficult than is the case for water pollution. A watershed is easily defined, however an "airshed" is a far more abstract concept. Finally, the number of pollutants contained in the emissions may be large and the effects of individual pollutants may be difficult to quantify.

The two national fee systems discussed below levy fees on sulphur dioxides (SO_2) emissions alone. While SO_2 is a major air pollutant, other pollutants may be equally important such as nitrogen oxides (NO_x), total reduced sulphides (TRS), ozone (O_3), carbon monoxide (CO), particulates, or chlorofluorocarbons (CFC). The choice of charging for SO_2 emissions was, in both cases, made for quite pragmatic reasons. First, the SO_2 emissions from each source can be measured indirectly based on the sulphur content of fuels used. In many countries, fuel combustion is the major source of SO_2 emissions and the data on fuel consumption and fuel sulphur content are readily available. Thus, measuring SO_2 emissions in this manner is relatively simple and cost-effective. Second, countries typically have more data on SO_2 emissions than on any other air pollutant and a greater understanding of the control technologies available for reducing SO_2 emissions.

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[1] In fairness, it must be stated that the same measurement costs would be incurred in the monitoring of the traditional regulatory permit approach to pollution control.

The South Coast Air Quality Management District, on the other hand, bases its emission fees on the annual emissions reported by holders of operating permits. As described below the emission fees are charged for a far broader number of pollutants.

This section ends with a description of several european air emission fee initiatives begun during 1990.

4.2 NORWAY

Introduction

On January 1, 1971, Norway introduced a tax on fuels derived from petroleum which is partly based on the fuels' sulphur content, as oil use is a major source of SO_2 emissions in that country.[2] The tax was introduced as a part of Norway's overall SO_2 abatement policy, however the tax has not been the major thrust of the abatement policy (OECD, 1980a). Rather, a regulatory product standard approach, which specifies the allowable sulphur content for different fuels depending on use, has been the main policy instrument, with the tax acting in a supporting role.

Fuel Sulphur Content Tax

The original fuel sulphur content tax had a base rate of 1 öre/litre (0.1¢) of oil, regardless of its sulphur content, and a variable rate calculated on the fuels' sulphur content above 0.5 percent by weight (OECD,1980a). The total tax per litre, in öre, was calculated as:

$$T = 1.0 + 0.2(SC - 0.5)$$

where T is the tax rate per litre and SC is the sulphur content expressed as a percentage by weight.

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[2] The review of Norway's fuel sulphur content tax is based on the material from OECD (1980a and 1989).

In 1976, the tax was modified to allow for rebates on the sulphur content portion of the tax based on any SO_2 emission abatement measures undertaken by polluters. Thus, the variable portion of the tax, while still quite low, provides a monetary incentive for polluters to reduce their SO_2 emissions.

Results

The tax is levied at the distribution stage on the oil suppliers. In 1977, tax revenue totalled Kr. 69 million ($9.3 million) of which Kr. 15 million ($2 million) came from the sulphur content portion of the tax (OECD, 1980a). That year, sulphur emission rebates totalled Kr. 1.5 million or 10 percent of the sulphur content portion of the tax.

The sulphur content portion of the tax had in, 1971, represented approximately 6 percent of the pre-tax price of heavy fuels. However, by 1979, due to large increases in the world price of oil, this percentage had dropped to 1.5 percent (OECD, 1980a).

On January 1, 1988, the fuel tax was modified and substantially increased (OECD, 1989). The base tax rate was increased to $42.00 per 1,000 litres of oil. The variable tax on the sulphur content of the oil is determined using the rates shown in Table 4-1. Annual revenue from the tax is expected to be approximately $41.5 million.

Comments

Because Norway's fuel tax provides a rebate for sulphur emissions abated, the tax serves, in part, as an emission fee. That is the sulphur portion of the tax applies only to the sulphur in the fuel which is actually emitted by the firm. The degree to which the tax will induce firms to undertake abatement measures will depend on the level of the tax relative to the costs of sulphur emission abatement. The ability of the sulphur content portion of the tax to induce firms to substitute low sulphur fuels for high sulphur fuels will depend on the level of the tax relative to the price differential between low and high sulphur content fuels.

The tax was introduced to generate revenue as well as to provide an economic incentive to reduce SO_2 emissions; thus the flat rate portion of the original tax. As an economic incentive, the purpose of the tax was to reduce the country's total emissions and not local concentrations. Therefore, the tax is uniform nation-wide and does not vary according to local conditions.

TABLE 4-1

NORWAY'S TAX ON FUEL SULPHUR CONTENT, 1988

Sulphur Content (% by Weight)	Tax Rate (per 1,000 litres)
0 - 0.25	\$3.00
0.25-0.5	\$6.00
0.5-0.75	\$9.00

Source: OECD, 1989.

4.3 JAPAN

Introduction

The rapid postwar industrialization of Japan was accompanied by cases of severe environmental degradation which led to the appearance of pollution-related diseases.[3] The diseases include the water pollution related diseases of minamata disease and itai-itai disease plus respiratory diseases related to air pollution. Minamata disease is the result of chronic mercury poisoning and is named after Minamata Bay, the area which the disease first occurred. The disease was caused by the discharges into the bay of methylated mercury, a by-product in the production of acetaldehyde, by the Japan Chisso Company. The mercury, once discharged, concentrated in marine organisms and made its way up the food chain to humans. The disease is painful, causes tumours and paralysis and is often fatal (Gresser et al., 1983).

Itai-itai disease, literally Japanese for "it hurts, it hurts", is caused by chronic cadmium poisoning. The disease was first reported in the Jintsu River delta and was the result of the upstream discharges from the Mitsui Mining and Smelting plant. The symptoms of the disease includes severe pain, splintering of the bone tissue, disfigurement and crippling, and often death (Gresser et al., 1983).

The health effects of air pollution first became a concern in Yokkaichi City where sulphur oxide concentrations in the early 1960s were six times higher than any other urban area in Japan (Gresser et al., 1983). The pollutants were a result of the large concentration of oil refineries, petrochemical industries and power plants in the area. The air contaminants were linked with respiratory ailments such as asthma, emphysema, and bronchitis.

The emergence of these diseases brought environmental concerns to the forefront of Japanese public opinion and resulted in the introduction of legislation to address the causes of and damages which resulted from these diseases.

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[3] The review of Japan's air emission fee system is based on the works of Gresser et al. (1981) and OECD (1980a).

Compensation of Pollution Victims

With the passage of the *1973 Law for the Compensation of Pollution-Related Health Injury*, Japan became one of the first countries to directly address the serious problem of injury to human health caused by the pollution which can accompany industrialization and urbanization. The *Act*, as its name says, provides compensation to people suffering from pollution-related health problems. In accordance with the OECD's "polluter pays principle", the necessary revenues for the compensation payments comes from the polluters.

Compensation is provided for people living in "designated areas" who suffer from diseases linked with the pollutants emitted within the area. The areas can be designated as either a Class 1 area ("nonspecific diseases") or Class 2 area ("specific diseases"). Specific diseases are diseases traceable to a specific pollutant and source, while nonspecific diseases could be caused by a number of pollutants and thus are not traceable to a single source. A Class 1 area is one where "marked air pollution has risen... and where diseases resulting from the effects of such air pollution are prevalent."[4] The diseases applicable to Class 1 areas are respiratory diseases such as pulmonary emphysema, chronic bronchitis, bronchial asthma, asthmatic bronchitis and their complications. An area is designated as a Class 2 area if it is suffering specific diseases, which is usually the result of water pollution. The specific diseases associated with different Class 2 areas includes minamata disease, itai-itai disease and chronic arsenic poisoning.

The administration of the compensation system was divided between two groups. Within every prefecture (province) and major municipality, a Pollution-Related Health Damage Certification Council was created with the responsibility for examining and certifying the victims of pollution-related health problems and the dispensation of compensation payments. The collection of the "pollution levies" from the polluters, for passage on to the prefectures, is the responsibility of the Pollution-Related Health Damage

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[4] Section 2 of the *Act* as cited by Gresser et al. (1981) p. 296.

Compensation Association, a quasi-government agency with industry representation. However, the setting of the levy per unit of pollution remains the responsibility of the government.

Under the *Act*, the compensation payments provided for "certified victims" includes:

- Medical Costs - the entire costs of medical treatment including the National Health Insurance portion;
- Disability Payments - the current system provides four classes of disability benefits based on the degree of disability which pays up to 80 percent of the victim's average wage;
- Survivor's Benefits - monthly payments of 70 percent of the deceased's average wage are paid over a ten year period to the family;
- Child Compensation - an allowance for afflicted children based on the "degree of difficulty in living experienced by the child";[5]
- Funeral Expenses - a flat sum of ¥285,000 ($2,740);[6] and
- Rehabilitation Facilities - rehabilitation facilities must be established in every province and city in a "designated area" .

The *Act* does not provide compensation for either pollution-related property damage or for victim pain and suffering. Property damage was not included because it was not felt to be as important as the health issue and it was deemed to be too administratively complex (Gresser et al., 1981). Victim pain and suffering was not included because the government of the day believed that the disability payments adequately addressed this issue.

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[5] Gresser et al. (1981), p. 295.

6. Calculated using the 1988 annual exchange rate as published by the Bank of Canada.

The Fee System

Revenue for the compensation of air pollution-related diseases in Class 1 areas comes from two sources: a "pollution levy" on SO_2 emissions and a vehicle weight tax. The choice of taxing SO_2 emissions as the basis for financing compensation payments was made for the following, mainly pragmatic, reasons:

- previous research had indicated that SO_2 emissions were the major cause of the victims' diseases;
- of all the air pollutants, the government possessed the greatest amount of data on SO_2;
- SO_2 emissions are proportional to the sulphur content of industrial fuel and its rate of consumption, therefore the emissions could be easily calculated; and
- SO_2 emissions could be easily monitored based on industry fuel consumption data.

An industry's emission tax will be based on the sulphur content of the fuels it consumes, less any desulphurization measures it undertakes. Thus, the tax can be reduced by the firm if it switches to a lower sulphur content fuel or if it undertakes either fuel or flue gas desulphurization measures. The tax is only collected from approximately 7,400 "large" emission sources which account for about 90 percent of the country's SO_2 emissions (Gresser et al., 1981).[7]

The unit tax rates are calculated annually based on the compensation budget for the coming year divided by the previous years estimated total emissions. Table 4-2 lists the unit tax rates for SO_2 emissions for the years 1974-1976. The base rate is the unit emission tax for SO_2 emissions anywhere in the country. However, prior to 1977, the tax rate was multiplied by a factor of 9 for emissions from firms located within a designated Class 1 area. This 9:1 ratio was chosen as it approximated the relative concentrations of SO_2 in and outside of the designated Class 1 areas. Thus, it cost far more to emit SO_2 in the highly polluted designated areas. In 1977, the fee system was modified, as shown in Table 4-3, to more closely relate the fees to the compensation payments required in each area.

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[7] Large sources are installations with a minimum capacity of 5,000 m^3 or 10,000 m^3 per hour, depending on the region in which it is located (OECD, 1980a).

The SO_2 emission tax is used to finance 80 percent of the Class 1 compensation payments with the remainder coming from the tax on vehicle weight. As automobile emissions accounted for approximately 20 percent of the country's SO_2 and NO_x emissions, a tax on vehicle weight was chosen as the simplest method of collecting the funds from this source of pollution.

Compensation for victims of Class 2 diseases directly related to specific pollutants discharged by specific facilities are paid directly by the firms involved.

Results

By April 1, 1977, the number of certified victims had reached 55,104 of which 53,416 had Class 1 nonspecific respiratory diseases and the remaining 1,788 had Class 2 specific diseases (Gresser et al., 1981). Of the total number of victims, 1,247 had died with 1,062 and 185 being victims of Class 1 and Class 2 diseases respectively.

Table 4-4 lists the revenues generated by the SO_2 emission tax and the vehicle weight tax for the compensation of Class 1 nonspecific diseases. While the total revenue generated by the taxes increased sharply, coincident with the increases in the tax rates, the costs of collecting, administering and dispersing the compensation remained at a constant 10 percent of the systems total costs (Gresser et al., 1981).

Comments

The purpose of Japan's pollution tax system was to provide a revenue mechanism for the funding of victim compensation and not specifically to act as a pollution abatement incentive device. Thus, the tax rate is set to meet the expected compensation budget and not to induce further industry expenditures on additional pollution abatement measures. The system does provide some abatement incentive, at least to run currently installed abatement equipment as efficiently as possible, but it is not known if the current tax rates are high enough to induce firms to install new equipment.

The pollution tax system also promotes economic efficiency as it forces firms to "internalize" some of their external (pollution) costs. However, because the compensation payments do not cover all of the firms' external costs, such as property damage and victim pain and suffering, the system cannot be said to act as a true "Pigovian" tax and will fall short of achieving complete economic efficiency.

The SO_2 emission tax has also been criticized for focusing on one pollutant as the source of respiratory ailments and ignoring other potentially harmful pollutants such as NO_x, CO and particulates. When the tax system was designed, these other pollutants were excluded because the government felt that a feasible method for collecting a tax did not exist but that the other pollutants would be included when a feasible collection system was developed (Gresser et al., 1981).

TABLE 4-2

JAPAN'S SO_2 EMISSIONS TAX RATES, 1974-1976

(Rate per m^3 of SO_2)

Year	Base Rate		Maximum Rate	
	Yen	$*	Yen	$*
1974	1.76	0.006	15.84	0.053
1975	8.59	0.029	77.31	0.265
1976	23.33	0.078	209.97	0.699

* Calculated using the average annual exchange rate as published by the Bank of Canada.

Source: Gresser et al., 1981.

TABLE 4-3

JAPAN'S SO_2 EMISSIONS TAX RATES, 1977

(Rate per m^3 of SO_2)

Area	Tax Rate	
	Yen	$*
Osaka, Amagasaki	536.63	2.14
Tokyo, Kanagawa, Aichi, Mie, Kobe	383.31	1.53
Chiba, Fuji	344.98	1.37
Okayama, Fukuoka	306.65	1.22
Other	42.59	0.17

* Calculated using the average annual exchange rate as published by the Bank of Canada.

Source: Gresser et al., 1981.

TABLE 4-4

SO_2 EMISSION TAX AND VEHICLE WEIGHT TAX REVENUE

(millions of Yen and Dollars*)

Year	SO_2 Emission Tax		Auto Weight Tax		Total	
	Yen	$	Yen	$	Yen	$
1974	2,342	7.9	550	1.8	2,892	9.7
1975	10,950	37.6	2,674	9.2	13,624	46.7
1976	35,631	118.5	8,791	29.2	44,422	147.8

* Calculated using the average annual exchange rate as published by the Bank of Canada.

Source: Gresser et al., 1981.

4.4 SOUTHERN CALIFORNIA

The South Coast Air Quality Management District, which comprises portions of the Counties of Los Angeles, Orange, Riverside and San Bernadino, started operation on February 1, 1977.[8] The District was given, by the state, the responsibility for comprehensive air pollution control in the south coast air basin. The goal of the District is to develop and implement a basin air management plan for attaining the U.S. federal air quality standards. The District is governed by a 12 member board. Three members of the board are appointed by the state and the remainder are appointed by county and municipal councils.

The District is authorized by California state law to "adopt fee schedules for the issuance of variances and permits to cover the cost of planning, inspection, and monitoring related thereto."[9] Under this authority the District has imposed three fee groups, administration fees[10], annual operating permit fees, and annual emission fees.[11] The administration and annual operating permit fees are based on the level of service and the complexity of the equipment for which a permit application is made. The administration fees ranged from $180 to $28,100 for the 1990/91 fiscal year, and the annual operating permits ranged from $150 to $1,200.

The District, which has levied emission fees since 1978, bases the fees on the total weight of the pollutants emitted annually by the permit holder. Tables 4-5 and 4-6 lists the pollutants for which fees are currently charged. For the pollutants listed in Table 4-5, annual emissions of less than 4 tons (100 tons for carbon monoxide) are not assessed a fee. The fee rates for the pollutants listed in Table 4-5 (except carbon monoxide) progressively increase as a permit holder's total annual emissions increase. Table 4-6 lists the fees for toxic contaminant and ozone depleter emissions.

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[8] Created by authority of the *Lewis-Presley Air Quality Management Act*, codified as California Health and Safety Code Division 26, Chapter 5.5, Section 40400 - 40540.

[9] California Health and Safety Code Section 40500 *et seq.*

[10] Included in the administration fees are a permit application processing fee, a change of ownership fee, a change of operating conditions fee and an alteration, modification, or addition fee.

[11] South Coast Air Quality Management District, Rule 301.

Permit holders are required to report their emissions for the previous calendar year using emission factors supplied by the District.[12] The permit holder must pay the fee within 60 days of receipt of a fee payment notice. Late payments are assessed a penalty of 25% of the original amount of the emission fee. Failure to report emissions within a year results in a penalty of 50% of the amount of the emission fee. If payment is not received within 120 days the District may revoke the operating permit. However, the District may also, on request from a permit holder, grant a time extension for payments due of up to 90 days.

Results

The revenues raised by the District's emission and permit fees are listed in Table 4-7. As shown, revenue from the fees is expected to increase by 49% from $57.5 million in 1988/89, to $85.7 million in 1990/91. The emission fees account for approximately 44% of the District's total revenue from all sources (South Coast Air Quality Management District, 1989).

Comments

The main purpose of the emission fees is to recover part of the District's air pollution control costs. However, the emission fees will without question provide an incentive for polluters to reduce their emissions. In addition, the emission fees, by varying between pollutant types, provides greater incentives for polluters to reduce their emissions of the more harmful types of pollutants.

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[12] Emission factors are the amount of air contaminants emitted per unit of time or per unit of material handled, processed, or burned.

TABLE 4-5

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT EMISSION FEES, 1990

(U.S. $ per ton emitted)

Pollutant Type	Total Annual Emission Range			
	4-25 tons	>25-75 tons	>75 tons	>100 tons
Organic Gases[a]	245	398	596	n.a.
Specific Organics[b]	44	70	105	n.a.
Nitrogen Oxides	141	228	343	n.a.
Sulphur Oxides	171	275	413	n.a.
Carbon Monoxide	n.a.	n.a.	n.a.	3.10
Particulate Matter	188	304	456	n.a.

Source: South Coast Air Quality Management District, Rule 301, 1990.

a. Excludes the ozone depleting substances listed in Table 4-5.

b. Includes trifluoromethane, dichlorotrifluoroethane (HCFC-123), tetrafluoroethane (HFC-134a), dichlorofluoroethane (HCFC-141b), and chlorodifluorethane (HCFC-142b).

n.a. - not applicable.

TABLE 4-6

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT TOXIC CONTAMINANTS AND OZONE DEPLETERS EMISSION FEES

Pollutant Type	Fee (U.S. $ per lb.)
Toxic Compounds	
Asbestos	1.20
Benzene	0.72
Cadmium	1.20
Carbon Tetrachloride	0.72
Hexavalent Chromium	1.20
Chlorinated Dioxins and Dibenzofurans	1.20
Ethylene Dibromide	0.72
Ethylene Dichloride	0.72
Ethylene oxide	0.72
Methylene Chloride	0.19
Ozone Depleters	
Chlorofluorocarbons (CFCs)	0.16
1,1,1-Trichloroethane	0.03

Source: South Coast Air Quality Management District, Rule 301, 1990.

TABLE 4-7

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT EMISSION AND PERMIT FEE REVENUE

(U.S. dollars)

Source	1988/89 Actual	1989/90 Estimated	1990/91 Budget
Emission Fees	$29,751,098	$35,600,000	$39,685,600
Annual Operating	$14,695,020	$20,700,000	$25,000,000
Processing Fees	$13,082,763	$13,094,000	$21,000,000
Total	$57,528,881	$69,394,000	$85,685,600

Source: South Coast Air Quality Management District, 1989 and 1990.

4.5 RECENT INITIATIVES

Increasing world concern about the effects of acid rain, resulting from SO_x and NO_x emissions, and the potential impacts of the greenhouse effect, resulting from CO_2 emissions, has led several european countries to adopt or consider new emission fees as a means of controlling the emissions of these gases and as a means of funding emission control measures. The recently announced initiatives of the Netherlands, France and Sweden are discussed below.

Netherlands

Concerns about the potential effects of global warming on both their nation and the world led the Dutch government, in its National Environment Policy Plan, to set as an objective the stabilization of their nation's CO_2 emission by the year 2000, at the 1989/90 average level (The Netherlands, 1989). This goal was later strengthened to stabilize their emissions at the 1989/90 level by 1994/95 (Metz, 1990). As part of their emission control strategy, the Netherlands implemented a CO_2 tax on fossil fuels effective February 1, 1990. This tax, sometimes referred to as a carbon tax, is based on the CO_2 generating potential per unit of energy of the different fuels. The tax rates are listed in Table 4-8.

The CO_2 tax is collected as part of the Netherlands' existing fuel excise tax which consists of two parts: a general fuel tax and an environmental levy (Metz, 1990). Previously the environmental levy had been based on the fuel's sulphur content and, for gasoline, its lead content (Stone, 1990). The CO_2 tax has simply been added on to the environmental levy portion of the tax resulting in an increase in the environmental levy of 5%, for leaded gasoline, to 180% for natural gas (Metz, 1990).

The tax is expected to raise revenue of Dfl 150 million (approximately $100 million) per year. The revenue will be used to finance part of the government's energy conservation program. However, the tax was not as yet meant to have a significant economic regulatory effect, due to the tax's relatively small impact of fuel prices, rather it serves as a revenue mechanism (Opschoor et al., 1989).

France

France implemented a tax on air pollution emissions effective May 13, 1990 (International Environment Reporter, 1990b).[13] Under the tax sulphur dioxide, nitrous oxides, and hydrochloric acid are taxed at the rate of 150 francs per ton. Other sulphide emissions are taxed based on their equivalency to sulphur dioxide. Non-methane hydrocarbons, solvents and volatile organic compounds (VOC) were to be taxed at the rate of 500 francs per ton, however the tax on these emissions was suspended although it may be put back in place in the next two to three years (International Environment Reporter, 1990b).

It is reported that revenue from the tax will be used by the Ministry of Environment for:

- prevention and reduction of both permanent and accidental air pollution;
- development of air pollution reduction and measurement technologies;
- administrative costs; and
- air quality improvement projects.

Sweden

The Swedish government has introduced a bill which would tax emissions of CO_2 , SO_x and NO_x (International Environment Reporter, 1990a). The government hopes these measure could reduce CO_2 emissions by 10 million tons and SO_x emissions by 15,000 tons per year.

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[13] Implemented by the Decree No. 90-983, of May 11, 1990.

TABLE 4-8

THE NETHERLANDS' CO_2 TAX RATES, 1990

Fuel	Units	Tax Rates	
		Dfl	$
Gasoline	100 litres	0.27	0.18
Heavy Fuel Oil	ton	3.28	2.20
Coal	ton	2.61	1.80
LPG	ton	3.38	2.30
Natural Gas	1000 m^3	1.79	1.20

Source: Metz, 1990.

SECTION FIVE

EXAMPLES OF SOLID AND HAZARDOUS WASTE DISCHARGE FEES

5.1 INTRODUCTION

The management of society's solid wastes has become a critical issue in many areas of the world. Nowhere, perhaps, has the situation become as severe as it has in the United States, particularly on its eastern seaboard. For example, New York State estimates that all existing state landfills will be full and closed by 1995 (New York, 1988). Many communities on the U.S. eastern seaboard now have to have their wastes trucked out of state for disposal at a cost which can exceed $100 per ton. In response, many U.S. states have pursued policies and legislation aimed at reducing their solid waste stream by implementing recycling, resource recover, and source reduction measures. For example, in 1987, New Jersey became the first state to make it mandatory for all municipalities in the state to implement recycling programs. To fund their new solid waste management programs some states have turned to state tipping fee surcharges at solid waste disposal facilities in order to provide the necessary revenues. These surcharges serve as a type of solid waste discharge fee and the surcharges and fees implemented by several U.S. states are examined in this section.

Another serious environmental problem facing the United States is the management of its hazardous wastes particularly the clean up of abandoned contaminated dump sites. It is estimated that hazardous wastes are generated in the U.S. at a rate of 700,000 tons per day (U.S., 1987). In addition, by 1987, 952 abandoned hazardous waste sites had been placed on the U.S. National Priority List (U.S., 1987). This list contains the sites which present the most serious potential threats to health and the environment in the U.S. and are thus, eligible for federal Superfund assistance.[1] To fund their hazardous waste regulatory costs and their contribution to the clean up costs of abandoned sites, many U.S. states have implemented hazardous waste disposal facility fees. Examples of use of the hazardous waste disposal fees are also examined below.

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[1] Superfund is the common name used for the trust fund established by the *Comprehensive Environmental Response, Compensation and Liability Act of 1980*, Public Law No. 96-510, July 18, 1982.

5.2 SOLID WASTE DISPOSAL FEES

The solid waste disposal fees of ten states, New Jersey, Illinois, Ohio, Pennsylvania, Minnesota, Colorado, Maine, Louisiana, California and Wisconsin, are reviewed below.

New Jersey

New Jersey first implemented a surcharge on the owner or operator of sanitary landfill sites on January 1, 1982, under the *New Jersey Recycling Act.*[2] The original surcharge was set at $0.12 per cubic yard (approximately $0.40 per ton) and generated $4.6 million in its first year. The surcharge was nearly tripled to $1.50 per ton effective July 1, 1987, with passage of the *Mandatory Statewide Source Separation and Recycling Act* (New Jersey, 1987). In addition, the surcharge coverage was expanded from just sanitary landfill operators to include all solid waste disposal facilities, except resource recovery facilities.[3] The *Act* has a sunset clause which terminates the surcharge on December 31, 1996.[4]

Revenue derived from the surcharge is deposited into the State Recycling Fund.[5] Surcharge revenues for the period 1985/86 to 1988/89 are listed in Table 5-1. Monies in the fund are allocated on the following basis:

- 40% - for municipal grants based on the tonnage of recyclable materials collected, processed and marketed from residential, commercial or industrial sources;

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[2] New Jersey, Law 1981, c. 278. Codified as R.S. 13:1E-92 et seq.

[3] Solid waste disposal facility is defined to include sanitary landfills, incinerators, resource recovery facilities, transfer stations or other plants for the disposal of solid waste, R.S. 13:1E-3(h).

[4] New Jersey, 1987, *Mandatory Statewide Source Separation and Recycling Act*, Section 39.

[5] New Jersey R.S. 13:1E-96.

- 35% - for low interest loans to recycling business ventures and for research and market development activities;
- 10% - for recycling education and publicity;
- 8% - for county recycling program planning and administrative costs; and
- 7% - for state recycling program planning and administrative costs.

TABLE 5-1

NEW JERSEY SOLID WASTE DISPOSAL SURCHARGE REVENUE

(U.S. dollars)

Fiscal Year	Revenue	Comments
	(000's)	
1985/86	$4,200	
1986/87	$3,833	
1987/88	$11,822	Rate increased
1988/89	$11,000	

Source: New Jersey Office of Recycling, 199

Illinois

Illinois first introduced disposal fees on sanitary landfill operators on January 1, 1987, under its *Environmental Protection Act*.[6] For landfill sites disposing of less than 150,000 cubic yards of solid waste per year a flat rate fee was imposed for each of the four size categories of landfill sites shown in Table 5-2. For landfill sites disposing of more than 150,000 cubic yards of solid waste per year a variable rate based on the quantity of solid waste disposed of is used. As shown in Table 5-2, the original rate was $0.45 per cubic yard or $0.95 per ton but the rate was increased, effective January 1, 1989, to $0.60 per cubic yard or $1.27 per ton.

TABLE 5-2

ILLINOIS LANDFILL DISPOSAL FEES, 1987-1989

Landfill Annual Disposal Rate (cubic yards)	Annual Disposal Fee 1987	Annual Disposal Fee 1989
< 10,000	$500	$650
10,000 - 50,000	$3,450	$4,650
50,001 - 100,000	$11,300	$15,500
101,000 - 150,000	$25,000	$33,350
>150,000	$0.45 per cu. yd. or $0.95 per ton	$0.60 per cu. yd. or $1.27 per ton

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[6] Illinois Public Health and Safety Code, 111 1/2, Sections 1001 et seq.

The following types of waste material have been given an exemption from the disposal fee:

- hazardous waste (which is subject to a separate fee discussed in Section 5.3 below);
- pollution control wastes;
- wastes from a recycling, reclamation or reuse process which renders at least 50% of its throughput reusable;
- wastes composted or recycled at the landfill;
- demolition or construction debris; and
- landscape waste.

A further exemption to the fee is granted if the applicant can show that all of the following conditions are met:

- the waste is non-putrescible and homogeneous and does not contain liquids;
- the combustion of the waste would not provide practical energy recovery or reduction of volume; and
- it is demonstrated that it is not technologically and economically reasonable to recycle or reuse the waste.

The fees collected are credited to the state's Solid Waste Management Fund and are used to finance the state's activities under Illinois' *Solid Waste Management Act*. Revenue from the fees, during their first three years of operation, were $16,205,362 in 1987, $15,406,520 in 1988, and $18,685,300 in 1989 (Illinois Environmental Protection Agency, 1990).

The state has also given local governments, in who's boundaries a solid waste disposal facility is located, the power to impose a tax or surcharge. However, the local government's surcharge or fee cannot exceed the state's fee schedule.

Ohio

In 1988, Ohio imposed a fee on the disposal of solid wastes.[7] The purpose of the fee was to pay for the cleanup of hazardous wastes found at solid waste disposal facilities. The fee rates, shown in Table 5-3, differentiate between the location from which the wastes originate relative to the location of the disposal facility. Thus, wastes generated within the county in which the facility is located are charged the lowest rate, while wastes generated outside of the county are charged a higher rate, and wastes generated outside of the state are charged the highest rate. This rate structure should encourage the siting of adequate disposal facilities within each county and discourage the importation of out of state wastes.

TABLE 5-3

OHIO SOLID WASTE DISPOSAL FEES, 1988-90

(U.S. dollars)

Origin of Wastes	Fee Per Ton		
	1988	1989	1990
Within the County in Which the Facility is Located	0.50	1.00	1.50
Outside the County in Which the Facility is Located	0.60	1.10	1.60
Out of State Wastes	0.75	1.25	1.75

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[7] Ohio R.C. Title 37 Section 3734.57.

Half of the revenue from the solid waste disposal fee is deposited in the state's Hazardous Waste Management Fund and the other half is credited to the Hazardous Waste Clean-up Fund.

Ohio has also given counties the authority to impose similar fees on solid wastes disposed of at disposal facilities located within the county's boundaries. In addition, municipalities may impose a fee of not more than 25 cents per ton of solid waste disposed within their boundaries.

Pennsylvania

Effective October 27, 1988, Pennsylvania imposed a "recycling fee" of $2 per ton of solid waste disposed of at municipal waste landfills and resource recovery facilities.[8] The fee is collected from the operator of the facility and must be remitted quarterly.[9] However, the process residue and non-processable wastes from a resource recovery facility, which is disposed of at a landfill, are exempt from the fee. For facilities which do not weigh the solid wastes received, a conversion factor of three cubic yards to one ton of solid waste is used to calculate the fee. The *Act* which established the fee included a sunset clause which terminates the fees on January 1, 1999, unless renewed by the state.

Since the imposition of the recycling fee a total of approximately $36 million has been collected (Pennsylvania Dept. of Environment and Resources, 1990). The fees collected are deposited into the state's Recycling Fund from which the monies are allocated on the following basis:

- at least 70% - for grants to municipalities for recycling programs, recycling coordinators, market and waste reduction research, and implementation programs;

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[8] Implemented under the *Municipal Waste Planning, Recycling and Waste Reduction Act*, 1988, Public Law 556, No. 101, Section 101 to 1904. Codified as Pennsylvania R.S. Title 53 Section 4000.101 to 4000.1904.

[9] Operators who pay their fee on time are given a 1% discount on the fees collected by them.

- up to 10% - for grants for municipal waste processing and disposal facility feasibility studies;
- up to 30% - for state public information, education and technical assistance programs dealing with litter control, recycling and waste reduction; and
- 3% or less - for fee collection and fund administrative costs.

Pennsylvania has also imposed a "Host Municipality Benefit Fee" of $1 per ton of solid waste disposed of at a municipal waste landfill or resource recovery facility. The fee is payable to the municipality in which the facility is located. If the municipality owns the facility the fee is collected only on waste generated outside of the municipality.

The state government also requires that each county establish a post-closure trust fund for each municipal waste landfill within the county's boundaries. The purpose of the trust fund is "for remedial measures and emergency actions that are necessary to prevent or abate adverse effects upon the environment after closure of the landfill."[10] Revenue for the trust fund comes from a fee of 25¢ per ton of solid waste received by each landfill.

Minnesota

Under two pieces of legislation, the *Metropolitan Landfill Abatement Act* and 1989 amendments to the *Waste Management Act*, Minnesota has implemented a state wide solid waste disposal fee.[11] The first *Act* imposed a fee of $0.50 per cubic yard of solid waste accepted at a mixed municipal solid waste disposal facility within the greater Minniapolis-St. Paul area effective January 1, 1985.[12] On January 1, 1990, the fee rate was increased to $2 per cubic yard at which time, under the second *Act*, the same fee system was imposed on mixed municipal solid waste facilities operating in the remainder of the state. The fees are collected from the facility operator and must be submitted to the state monthly.

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[10] Pennsylvania R.S. Title 53 Section 4000.1108.

[11] Minnesota R.S. Metropolitan Government Section 473.841 to 473.847, and Minnesota R.S. Environmental Protection 115A.922 respectively.

Both fees exempt waste residue from a recycling, energy-from-waste or resource recovery facility if there is a 85% or greater reduction in the volume of the waste processed by the facility. Thus, the fees provide an incentive to undertake both recycling and resource recovery and an incentive for these facilities to be operated efficiently.

The fees collected by the Department of Revenue are deposited into four special accounts as follows:

- Metropolitan Solid Waste Landfill Fee:
    - Three fourths of the fees are deposited into the Metropolitan Landfill Abatement Account which was established to reduce "the need for and practice of land disposal of mixed municipal wastes in the metropolitan area." The funds may be used for resource recovery projects, recyclable waste market development, public education, planning, grants to counties, program administration and solid waste research.
    - One fourth of the fees are deposited into the Metropolitan Landfill Contingency Action Trust Fund which was established to assist with water supply monitoring and site closure and post-closure costs.
- Greater Minnesota Landfill Cleanup Fee:
    - Three fourths are deposited to the Greater Minnesota Landfill Maintenance Fund which is to be used to assist counties with landfill maintenance including closure and post-closure costs. The funds are distributed to counties based half on per capita

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[12] The metropolitan area is defined as the seven counties of Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington.

grants and half on the counties' share of the state's mixed municipal solid waste disposal facilities.

- One fourth to the Greater Minnesota Landfill Contingency Action Fund which is used to finance any closure or post-closure costs incurred by the state.

Colorado

Effective January 1, 1986, Colorado imposed a fee on the disposal of solid wastes at an attended solid waste disposal facility.[13] The fee is collected by a facility operator, who must remit the revenues collected quarterly. The operator is entitled to keep 5% of the fees collected by him to defray his administrative costs of collecting the fee. The fee is imposed at the following rates:

- five cents per load transported by a non-commercial motor vehicle;
- ten cents per load transported by a non-commercial truck; and
- fifteen cents per cubic yard per load transported by a commercial vehicle.

Revenue derived from the fee are deposited into the state's Hazardous Substance Response Fund.[14] Revenue from the fee is approximately $1.7 million per year (Colorado Department of Health, 1990). Monies in the fund may be used to:

- maintain an inventory of all sites and facilities at which hazardous substances have been disposed of in the state;
- supply state matching funds for response action at national priority list sites under the federal Superfund legislation; and
- provide any post-cleanup monitoring and maintenance required.[15]

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[13] Colorado R.S. 25-16-104.5. An attended solid waste site is defined as a site at which an attendant is present during normal hours of operation.

[14] The Department of Health may first deduct up to 5% of the revenues collected for administration and collection costs.

[15] Colorado R.S. 25-16-104.6.

The state is currently considering legislation which would double the fee rates as of January 1, 1991. However, the fee has a sunset clause which terminates the fee on January 1, 1995.

Note that Colorado's solid waste disposal fee was implemented to fund the state's hazardous waste management costs. In particular the fee was established "to provide the state's share of the response costs of cleaning up..." contaminated sites under the federal *CERCLA*.[16]

Maine

Effective October 1, 1989, Maine introduced three solid waste management fees.[17] The first is a municipal disposal surcharge of $4 per ton of any municipal solid waste disposed of at a commercial landfill facility. A second surcharge of $1.50 per ton was imposed on solid wastes delivered to a commercial solid waste disposal facility from a municipality which is not meeting the state's waste reduction goals. The third fee was imposed on the disposal of "special wastes" which are difficult to dispose of solid wastes that are not classified as a hazardous waste.[18] The rates per ton for each of the ten categories of special waste are given in Table 5-4.

Both fees are collected by the facility operator who must remit the revenues quarterly. Operators who remit the payments on time are given a 1% discount on the amount of the fees collected.

Revenue derived from the fees are deposited in the Maine Solid Waste Management Fund and are used to finance the administrative costs of support programs operated by the Maine Waste Management Agency and the state's Department of Environmental Protection.[19] In the first three quarters of operation, revenue from the municipal disposal surcharges and the special waste fees totalled $84,311 and $767,764 respectively (Maine Waste Management Agency, 1990).

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[16] Colorado R.S. 25-16-101.

[17] Maine R.S. Title 38 Sections 2203 and 2204.

[18] Special wastes are defined as "any solid waste generated by sources other than domestic and typical commercial establishments that exists in such an unusual quantity or in such a chemical or physical state, or any combination thereof, that may disrupt or impair effective waste management or threaten the public health, human safety or the environment and requires special handling, transportation and disposal procedures", Maine R.S. Title 38 Section 1303 subsection 34.

TABLE 5-4

MAINE SPECIAL WASTE DISPOSAL FEES

(U.S. dollars)

Category	Disposal at a Commercial Landfill	Disposal at a Municipal Landfill
Asbestos	$6/cu. yd.	$2/cu. yd.
Oil Spill Debris	$25/ton	$25/ton
Residuals from Soil Decontamination	$6/ton	$2/ton
Waste Water Facility Sludge	$2/ton	$2/ton
Ash, Coal & Oil	$6/ton	$2/ton
Paper Mill Sludge	$6/ton	$2/ton
Industrial Waste	$6/ton	$2/ton
Sandblast Grit	$6/ton	$2/ton
Misc. Special Waste	$6/ton	$2/ton
Municipal Solid Waste Incinerator Ash	$2/ton	$2/ton

Source: Maine R.S. Title 38 Section 2203.

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[19] Maine R.S. Title 38 Section 2201.

Louisiana

Under its *Solid Waste Recycling and Reduction Law*, Louisiana authorized the secretary of the Department of Environmental Quality to impose fees on solid waste management facilities.[20] A solid waste management facility is defined as "any solid waste disposal area, volume reduction plant, transfer station or other facility the purpose of which is resource recovery or the disposal, recycling, processing, or storage of solid waste and which is owned or operated by or receives solid waste from a parish or municipality."[21] The fees can be collected starting on July 1, 1990, but the fee rate is not to exceed 20 cents per ton. In addition, the fees are waived for any facility that reaches and maintains a 25% waste reduction goal. Revenues derived from the fee are to be used to administer the *Law*.

California

California has implemented a solid waste landfill tipping fee under its *California Integrated Waste Management Act* of 1989.[22] The fee came into effect on January 1, 1990, at the rate of $0.50 per ton until July 1, 1990.[23] The California Waste Management Board was authorized to adjust the rate to cover its 1990/91 budget, on July 1, 1990, but the rate was not to exceed $0.75 per ton. After July 1, 1991, the Board could raise the fees to a maximum of $1.00 per ton. The Board may exempt from the fee operators of solid waste landfills which receive, on a monthly average, less than 5 tons per operating day of solid wastes. The fees collected are credited to the Integrated Waste Management Account of the state's Solid Waste Management Fund.

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[20] *Solid Waste Recycling and Reduction Law*, 1989, Act No. 185, codified as Louisiana R.S. 30:2411 to 2422.

[21] Louisiana R.S. 30:2412(14).

[22] California Statutes, 1989, c. 1095.

[23] California Public Resources Code, Section 48000.

Wisconsin

The State of Wisconsin has imposed several volume based fees on the operators of solid and hazardous waste disposal facilities.[24] The fees include a waste management fee, a groundwater fee, an environmental repair fee, and a well compensation fee. The rate per ton under these fees varies depending on the category of the waste being disposed. Table 5-5 lists the 20 waste categories used by the state. Table 5-6 presents the rates per ton for each of the four fees.

Under the environmental repair fee, an additional surcharge is imposed on owners of solid or hazardous waste disposal facilities which have not been designated as an "approved facility".[25] The surcharge is 25% of the environmental repair fee for facilities which have entered an agreement with the state to close the facility by July 1, 1999, and 50% for facilities where ~~were~~ no such agreement has been reached.

On collection, the fees are deposited into one of the three following special accounts which may be used only for the purposes indicated:

- The Waste Management Fund receives revenue derived from the waste management fees. Monies in this account may be used by the state for closure and post-closure costs, prevention of imminent hazards, and corrective actions required at waste disposal facilities where ~~were~~ the owner's responsibility for the site has terminated, the owner has gone bankrupt or where ~~were~~ the owner fails to comply with state requirements. In 1988/89, the fund received revenue of $146,817 (Wisconsin Bureau of Solid Waste Management, 1990).
- The Groundwater Fund receives the revenues derived from the groundwater fee. This fund is used to guarantee the management of groundwater surrounding a disposal facilities, to maintain groundwater standards and to implement a state groundwater monitoring program. In 1988/89, the fund received revenue of

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[24] Wisconsin R.S. Sections 144.441 and 144.442.

[25] An "approve facility" means a solid or hazardous waste disposal facility with a plan of operation approved by the state, R.S. 144.44(3).

$593,711 from the groundwater fee (Wisconsin Bureau of Solid Waste Management, 1990).

- The Environmental Repair Fund receives revenue from both the environment repair fee and the well compensation fee. Revenue from the fees totalled $888,027 in 1988/89 (Wisconsin Bureau of Solid Waste Management, 1990). Monies from the fund are used to:

  - investigate and analyze land disposal facilities and to repair facilities which present substantial danger to public health or the environment;

  - assist with costs associated with unanticipated contamination at "approved" facilities;

  - respond to any emergencies at a land disposal facility where a delay will result in imminent risk to public health or safety to the environment;

  - provide matching monies for U.S. federal Superfund cleanup activities; and

  - respond to spills and abandoned containers.

TABLE 5-5

WISCONSIN WASTE CATEGORIES

Category	Description
1.	Municipal Solid Waste
2.	Ashes and Sludges for Electric and Process Steam Generating Facilities
3.	Pulp or Papermill Sludges Produced by Waste Treatment or Manufacturing Processes
4.	Manufacturing Process Solid Waste from Foundries
5.	Sludges Produced by Municipal Wastewater Treatment Plants
6.	All Other Solid Wastes Not Designated as Hazardous
7.	Hazardous Wastes
8.	Hazardous Ashes or Sludges from Electric or Process Steam Generating Facilities
9.	Hazardous Sludges Produced by Waste Treatment or a Manufacturing Process
10.	Hazardous Manufacturing Process Solid Wastes from Foundries
11.	Hazardous Sludges Produced by Wastewater Treatment Facilities
Mine Wastes	
12.	Hazardous Tailing Solids
13.	Nonhazardous Tailings Solids or Non-acid Producing Taconite Tailing Solids
14.	Hazardous Sludge
15.	Nonhazardous Sludge
16.	Hazardous Waste Rock
17.	Nonhazardous Waste Rock or Non-acid Producing Taconite Waste Rock
18.	Prospecting or Mining Waste Not Specified in Categories 12 through 17
Other Wastes	
19.	Ash from Incineration for Energy Recovery
20.	Exempt Waste - Used for Daily Cover, Berms, Dikes, etc. at a Waste Disposal Facility

TABLE 5-6

WISCONSIN SOLID AND HAZARDOUS WASTE FEES

Waste Type	Categories	Waste Management Fund Fee*	Groundwater Fund Fee	Environmental Repair Fee	Well Compensation
Solid	1,5,6	3.5/1.5	10	50	1
Industrial	2,3,4,19	3.5/1.5	10	20	1
Hazardous	7	15	10	50	1
Other Hazardous	8,9,10,11	1.5	10	50	1
Mining	12-18		1	1	0
	12	1.5			
	13	0.2			
	14	1.0			
	15	0.5			
	16	0.3			
	17	0.1			
	18	0.5			

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* Where 2 rates appear the higher rate is for waste disposed of at a facility where the owner has a long-term care responsibility of 20 years after closure of the facility and the lower rate is for a facility with a 30 year long-term care responsibility.

5.3 HAZARDOUS WASTE DISPOSAL FEES

The hazardous waste disposal fees of the U.S. federal government and eight U.S. states, California, Ohio, Illinois, Maine, Missouri, Louisiana, Utah, and Pennsylvania, are reviewed below.

United States

The United States has an enormous hazardous waste management problem. It is estimated that the U.S. produces hazardous wastes at a rate of 700,000 tons per day, or 250 million tons per year (U.S., 1987). In an attempt to deal with the problem of abandoned hazardous waste dump sites, a legacy of past environmental errors, the U.S. enacted the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA), better known as Superfund.[26]

Included within the *Act* was a tax of $2.13 per dry weight ton of hazardous waste received by a "qualified hazardous waste disposal facility" which came into effect on October 1, 1983. The tax was collected from the owner or operator of the facility. However, the tax did not apply to any hazardous waste which would not remain at the disposal facility after the facility had been closed.

Revenue from the tax was credited to the "Post-closure Liability Trust Fund".[27] Over the period 1981-1985, revenue from the tax totalled $15.6 million (Kozielec, 1989). The tax and trust fund were repealed by the *Superfund Amendments and Reauthorization Act of 1986*, as it was thought that the tax might discourage waste generators from using qualified waste disposal facilities and to avoid penalizing waste generators who were already using these facilities (Kozielec, 1989).[28]

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[26] Public Law No. 96-510, July 18, 1982.

[27] Section 232 of the *Act*.

[28] Public Law No. 99-499, October 17, 1986.

The purpose of the U.S. hazardous waste tax and the Post-closure Liability Trust Fund was for the federal government to assume liability for any damages resulting from a waste disposal facility which had operated and closed in accordance with all federal government regulations.[29] However, if the tax was intended to serve in lieu of insurance premiums for the wastes deposited, then the tax rates should have varied by the type of wastes disposed, in accordance with the relative risks associated with each type of waste, rather than use a constant rate for all waste types.

California

California first introduced hazardous waste disposal fees in 1974, however the fees have had a history of continuous change since they were introduced.[30] The fees only apply to the disposal of hazardous wastes to land. The various fee rates employed by California over the period 1974-1990, are listed in Table 5-7. Starting in 1983, California began to vary the fee for different categories of hazardous wastes. The variation in the fee attempts to reflect the relative degree of risk posed by each waste category. Definitions for each waste category are provided in Table 5-8.

The 1985 amendments to the fees moved the liability for the payment of the fee from waste disposal site operators to the hazardous waste generators. This change in the fee collection point greatly increased the administration of the fee collection as the number of accounts paying the fees went from less than 200 to over 12,000 (California State Board of Equalization, 1988).

California provides and exemption from the fee for the following types of wastes:

- hazardous wastes which the state or local agency, or its contractor removes from a release of hazardous wastes caused by another person;

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[29] Section 107(k) of *CERCLA*.

[30] California Health and Safety Code, Sections 25174.1 to 25174.11.

TABLE 5-7

CALIFORNIA HAZARDOUS WASTE TAX RATES

(U.S. $ per ton)

Fiscal Year	Base Rate	Restricted Wastes	Extremely Hazardous	RCRA Exempt*	Double Lined Impoundment	Mineral Waste	Out-of-State Disposal	Incinerator or Treatment*
1974/75	0.60							
1981/82	1.00							
1982/83	4.00							
1983/84	6.40	18.00						
1984/85	9.92	19.84	19.84	2.48	0.99			0.50
1985/86	11.25	22.50	22.50	2.81	1.13	2.81		0.56
1986/87	24.16	48.32	48.32	6.04	2.42	6.04	12.08	1.21
1987/88	36.13	72.26	72.26	9.03	3.61	9.03	18.07	1.81
1989/90	52.50	103.00	103.00	13.12	5.25	13.12	18.38	2.63
1990/91	52.50	103.00	103.00	13.12	5.25	13.12	21.00	2.63

* On first 5,000 tons disposed of each month.

Source: California State Board of Equalization, 1988, and

TABLE 5-8

CALIFORNIA HAZARDOUS WASTE CATEGORIES

Hazardous Waste

A waste which because of its quantity, concentration, or physical, chemical, or infectious characteristics cause, or significantly contributes to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness, or poses a substantial present or potential hazard to human health or environment when improperly treated, stored, transported, or disposed of or otherwise managed, or wastes which meet criteria established by the Department.

Restricted Hazardous Waste

(1) any hazardous waste designated by the department as a restricted waste because of its toxicity, mobility or persistence or its ability to accumulate in plants or animals; and

(2) any hazardous waste which contains any of the following substances in the concentration indicated:
cyanide at 1,000 milligrams per litre;
arsenic at 500 milligrams per litre;
cadmium at 100 milligrams per litre;
chromium (VI) at 500 milligrams per litre;
lead at 500 milligrams per litre;
mercury at 20 milligrams per litre;
nickel at 134 milligrams per litre;
selenium at 100 milligrams per litre;
thallium at 130 milligrams per litre;
PCBs at 50 milligrams per litre;
waste with a pH of two or less; and
halogenated organic compounds at 1,000 milligrams per kg.

TABLE 5-8 CONTINUED

CALIFORNIA HAZARDOUS WASTE CATEGORIES

Extremely Hazardous Waste
Any hazardous waste or mixture of hazardous waste which, if human exposure should occur, may likely result in death, disabling personal injury or serious illness caused by the waste because of its quantity, concentration, or chemical characteristics.

RCRA Exempt Waste
Hazardous wastes not regulated under Subtitle C of the federal *Resource Conservation and Recovery Act of 1976.*

Double Lined Impoundment Wastes
Hazardous wastes disposed of in a double lined surface impoundment which meets the Department's requirements for leachate control, monitoring wells, a vadose zone monitoring system, and an enforceable site closure plan as approved by the Department.

Mineral Wastes
Wastes which result from the extraction, benefication, and processing of ores and minerals, including phosphate rock and the overburden from the mining of uranium ore which is not elsewhere classified.

Incineration or Treatment Residues
A solid hazardous waste resulting from incineration or dechlorination, or a solid hazardous waste resulting from a treatment method which results in free liquid removal, removal of volatile organic constituents, and a minimum waste volume reduction of 50% and which has been approved by the Department.

- hazardous wastes collected by the state or local agency from a household hazardous waste collection program; and
- hazardous wastes generated by a local vector control agency.

Revenue from the fees is deposited into the state's Hazardous Substance Account.

Illinois

Under its *Environmental Protection Act*, Illinois imposed hazardous waste disposal and treatment fees effective January 1, 1980.[31] Table 5-9 lists the disposal and treatment fees and the changes in the fees since they were first introduced. The fees are collected from the owner or operator of a waste disposal or treatment facility. The disposal fee has a maximum annual limit, also shown in Table 5-9, for individual waste generators provided that the wastes disposed of are disposed of at the site at which they were generated or are disposed of off site at monofills.[32] The *Act* also exempts the following wastes provided that they were generated within Illinois:

- sludge from publicly owned sewage works;
- coal mining waste and refuse;
- bottom boiler ash, flyash and flue gas desulphurization sludge from public utility electric generating facilities; and
- bottom boiler ash and flyash from incinerators processing only municipal wastes.

Ninety percent of the fees collected are deposited into the state's Hazardous Waste Fund with the remaining 10% deposited into the state's Hazardous Waste Research Fund. Monies in the Hazardous Waste Fund are used to take preventive and corrective actions whenever there is a release, or substantial threat of a release, of a hazardous substance or pesticide. Monies in the Hazardous Waste Research Fund are used (1) to assist in

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[31] Illinois Public Health and Safety Code 111 1/2 Section 1001-1045.

[32] Monofills are defined as "a facility, or unit at a facility, that accepts only wastes bearing the same USEPA hazardous waste identification number, or compatible wastes as determined by the Agency", Section 1022.2 (b)(6).

TABLE 5-9

ILLINOIS HAZARDOUS WASTE FEES, 1980-1991

	1980	1984	1989	1990	1991
Disposal Fee[a]					
$/gallon	0.01	0.03	0.06	0.075	0.09
$/cu. yd.	2.02	6.06	12.12	15.15	18.18
Maximum Disposal Fee[b]	n.a.	$10,000	$20,000	$25,000	$30,000
Treatment Fee[c]					
$/gallon	n.a.	0.01	0.02	0.025	0.03
$/cu. yd.	n.a.	2.02	4.04	5.05	6.06
Underground Injection Well Disposal Fee					
Up to 10,000,000 gallons		$2,000	$6,000	$6,000	$6,000
10,000,000 - 50,000,000		$5,000	$15,000	$15,000	$15,000
>50,000,000 gallons		$9,000	$27,000	$27,000	$27,000

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a. Except underground injections well disposal sites.

b. Maximum annual fee for a single waste generator provided the wastes are disposed of at the site at which the wastes are generated or deposited into monofills off-site.

c. Treatment does not include the recycling, reclamation or reuse of the wastes.

research and development intended to recycle, reduce, separate or detoxify hazardous wastes, (2) for monitoring, educational and research activities related to the protection of groundwater, and (3) to administer the Illinois' *Health and Hazardous Substance Registry Act*. However, the *Environmental Protection Act* also requires that at least 50% of the fees collected be used for response actions at contaminated sites within the state which have been placed on the federal National Priority List. In addition, up to 30% of the funds collected may be used for groundwater protection activities. During the fiscal year 1989/90, revenue from the fees totalled $1,981,000 (Illinois Environmental Protection Agency, 1990).

Ohio

Ohio imposed hazardous waste disposal fees, to be collected by the owner or operator of the disposal facility, in 1980.[33] The fees differentiate between the method of disposal and between disposal on the site at which the wastes were generated and disposal off site.[34] The fee rates are:

- for disposal by deep well injection:
    - $2.00 per ton for on site disposal; and
    - $4.50 per ton for off site disposal.

- for disposal by landfill:
    - $4.00 per ton for on site disposal; and
    - $9.00 per ton for off site disposal.

- for treatment of wastes off site $2.00 per ton.[35]

For hazardous wastes generated outside of the state the fees are set equal to the fees imposed by the state in which the wastes were generated, or to Ohio's rates whichever is greater. This measure will discourage the shipping of wastes to Ohio from states with higher disposal fees.

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[33] Ohio R.C. Section 3734.18.

[34] On site disposal includes the use of "satellite facilities" which are off site facilities owned by the generator of the hazardous wastes, R.C. 3734.02(E).

[35] The definition of "treatment" does not include "any method, technique, or process designed to recover energy or material resources from the wastes or to render the wastes amenable for recovery", R.C. Section 3734.18(E).

The recycling of hazardous wastes is exempt from the fee. In addition, for on site disposal facilities a maximum fee was established of $25,000 for facilities disposing of 100,000 tons or less of hazardous wastes and $50,000 for facilities disposing of more than 100,000 tons.[36]

The fees are paid by the owner or operator of the facility on the anniversary date of the issuance of the facility's operating permit. Revenue from the fees is credited to the state's Hazardous Waste Facility Management Fund which is used to finance the administration of the state's hazardous waste program.

To assist local governments, in who's boundaries a hazardous waste disposal or treatment facility is located, with the hazardous waste management costs associated with these facilities, a further levy equal to 10% of the fees described above is paid by the facility owner or operator directly to the municipality.

Maine

Maine implemented a number of volume based hazardous waste fees in 1981.[37] As shown in Table 5-10, the fee schedule distinguishes between different methods of managing hazardous wastes. The fee rates were revised effective June 29, 1987, to base the fees on the weight of the wastes rather than their volume. However, a cap of $15,000 per year has been placed on the fees payable by an individual for the on site disposal of their hazardous wastes.

For hazardous wastes generated out of the state and transported into Maine, the fee rates shown in Table 5-10 are doubled unless the state from which the waste originated has a reciprocity agreement with Maine on the charging of disposal fees.

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[36] For satellite facilities the maximum fess are $37,500 and $75,000 respectively.

[37] Maine R.S. Title 38 Sections 1319-B to 1319-K.

TABLE 5-10

MAINE HAZARDOUS WASTE DISPOSAL FEES

Management Method	1981	1987
	(¢/gallon)	(¢/pound)
Disposal at the site of waste generation	12.0	2.0
Storage at the site of generation for more than 90 days but less than 6 calendar months	3.0	0.5
Transportation of the wastes off site to a disposal facility	15.0	2.0
Transportation of wastes off site to a		
treatment facility	9.0	1.5
storage facility	6.0	1.5
recycling facility	6.0	1.5
Transportation, collection or storage of waste oil	n.a.	1.0/gallon

Source: Maine R.S. Title 38 Section 1319-I.

Revenue from the fees are deposited into the Maine Hazardous Waste Fund. Revenue from the fees totalled $988,193 in the 1988/89 fiscal year (Maine Department of Environmental Protection, 1990). Monies in the fund may only be used for:

- removal or abatement costs for an unlicensed discharge or threatened discharge of hazardous wastes;
- purchase of hazardous waste and waste oil testing, inspection and monitoring equipment and supplies, and response and compliance personnel and the training of personnel; and
- inspection or supervision of hazardous waste activities and hazardous waste handlers.

Missouri

Under the *Missouri Hazardous Waste Management Law*, Missouri has implemented two fees on generators of hazardous wastes.[38] The first fee, imposed effective January 1, 1982, is used to fund the administrative costs of the Department of Natural Resources' hazardous waste management program.[39] The fee is based on the quantity of hazardous wastes registered with the Department by the generator during the previous year. The fee rate is set annually by regulation but the fee cannot exceed $1 per ton of hazardous wastes registered. In addition, a cap of $10,000 per generator per year has been placed on the fee, and no fee is payable by a generator of less than ten tons per year.

A second fee of $25 per ton on "hazardous waste which is discharged, deposited, dumped or placed into or on the soil as final action" became effective on June 27, 1983.[40] In addition, a fee of $2 per ton was imposed on all hazardous wastes transported off site. These fees are not imposed on:

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[38] *Missouri Hazardous Waste Management Law*, Missouri R.S. Section 260.350 to 260.480.

[39] Missouri R.S. Section 260.380.

[40] Missouri R.S. Section 260.475.

- generators of less than 10 tons annually;
- hazardous wastes disposed of as part of a remedial plan for an abandoned or uncontrolled hazardous waste site;
- fly ash, bottom ash, slag waste and flue gas emission control wastes generated primarily from the combustion of fossil fuels;
- solid wastes from the extraction, benefication or processing of ores or minerals;
- cement kiln dust waste;
- waste oil; and
- hazardous waste that is:
    - reclaimed or reused for energy and materials;
    - transformed into new products which are not wastes;
    - destroyed or treated to render the waste nonhazardous; or
    - wastes discharged to a publicly owned treatment works.

The disposal and transportation fees are paid into the Hazardous Waste Remedial Fund.[41] Monies in the fund can be used for the nonfederal share of the costs of remedial actions at abandoned sites and other expenditures required under the federal *CERCLA*. However, monies from the fund can only be used after the Department makes "all reasonable efforts" to have the owners or operators voluntarily pay the costs of any necessary remedial actions.

Louisiana

Effective on July 1, 1984, Louisiana imposed a tax upon "the disposal of any hazardous waste and on hazardous waste stored for more than ninety days for the purpose of eventual incineration at sea".[42] Disposal is defined as "the discharge, deposit, injection, dumping or placing of any hazardous waste ... into or on any land or water in a hazardous disposal facility in such a manner that the hazardous waste so disposed becomes part of the surrounding land or water".[43] The tax rates, shown in Table 5-11, differentiate between hazardous waste disposed of at the site of generation, wastes disposed of off site, and the disposal of "extremely hazardous" wastes. Extremely hazardous wastes are "certain wastes which have been listed in the Louisiana Hazardous Waste Regulations of the Department of Environmental Quality...".[44] Thus, the rates provide an incentive for hazardous waste generators to dispose of their wastes on the site at which they were produced and an increased incentive to avoid the generation of extremely hazardous wastes.

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[41] Missouri R.S. Section 260.480.

[42] Louisiana R.S. 47:822.

The *Act* provides an exemption from the tax for a waste generator who voluntarily removes hazardous wastes from an inactive or abandoned site. This provides a partial incentive for those responsible for a contaminated site to voluntarily undertake cleanup action.

The tax is collected from both facility operators and from waste generators who dispose of their wastes on site. The tax collected must be remitted quarterly. Revenue from the tax is deposited into the state's Environmental Programs Trust Fund.[45] During 1989, revenue from the tax totalled $8.6 million (Louisiana Pollution Control Agency, 1990).

Utah

Under 1986 amendments to its *Solid and Hazardous Waste Act*, Utah imposed a hazardous waste disposal fee.[46] The fee is collected from the owner or operator of any commercial hazardous waste disposal facility or site which primarily receives wastes generated by off site sources. Thus, the disposal of hazardous wastes on the site at which they are generated

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[43] Louisiana R.S. 47:821, B(1).

[44] Louisiana R.S. 47:821, B(6)(b).

[45] Louisiana R.S. 47:832.

[46] Utah, *Solid and Hazardous Waste Act*, R.C. 26-14-1 to 25. Disposal means "the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid or hazardous waste into or on any land or water so that such waste or any constituent thereof may enter the environment, be emitted into the air, or discharged into any waters, including groundwater", Section 26-14-2 (5).

TABLE 5-11

LOUISIANA HAZARDOUS WASTE DISPOSAL TAX, 1984-1998

(U.S. $ per dry weight ton)

Year	Disposal On Site	Disposal Off Site	Extremely Hazardous Waste
1984-87	5	10	n.a.
1988	10	20	25
1989	11	21	26
1990	12	22	27
1991	13	23	28
1992	14	24	29
1993	15	25	30
1994	16	26	31
1995	17	27	32
1996	18	28	33
1997	19	29	34
1998	20	30	35

Source: Louisiana R.S. 47:823.

are exempt from the fee. The original fee was $3 per ton of hazardous waste received by a facility effective March 1, 1986. The fee was increased effective March 1, 1988, to $6 per ton for hazardous waste generated within the state and $9 per ton for hazardous wastes generated outside of the state. The fees were again increased in 1988, to $8 per ton and $20 per ton for hazardous wastes generated within the state and outside the state respectively.

Ten percent of the fees collected by a facility are allocated to the county in which the facility is located. The remainder is deposited into the state's general fund.

Pennsylvania

Under its *Hazardous Site Cleanup Act* of 1988, Pennsylvania imposed a set of hazardous waste transportation and management fees.[47] The transportation fee is assessed for all hazardous waste transported within the state, whether or not the wastes originated within the state. The rate for the fee is $3 per ton of hazardous waste transported except for hazardous wastes transported to or from a recycler, for which the rate is reduced to $1.50 per ton.

The management fees are assessed on operators of hazardous waste management facilities in the state based on the quantity of wastes stored, treated or disposed of by the facility. A management fee is not assessed for hazardous wastes which are reused or recycled in accordance with the state's regulations. In addition, no management fee is charged for hazardous wastes stored at the site at which the wastes were generated or stored prior to recycling at a commercial recycling facility. The management fee rates are:

- $2 per ton of hazardous wastes stored at a commercial hazardous waste management facility;
- $5 per ton of hazardous wastes treated or incinerated at a commercial hazardous waste management facility;

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[47] Public Law 756, No. 108, Sections 101 to 1305, October 18, 1988. Codified as Pennsylvania R.S. Title 35 Section 6020.101 to 6020.1305.

- $8 per ton of hazardous wastes disposed of at the site at which it was generated; and
- $12 per ton of hazardous wastes disposed of at a commercial disposal facility.[48]

The fees may be adjusted by regulation but must be set to raise annual revenues of $5,000,000 plus the administrative costs of collecting the fees. The fee rates are also set to encourage "preferred hazardous waste management practices" thus, recyclers are not charged a fee, storage is charged the lowest rate, the treatment or incineration of the wastes at a hazardous waste management facility has the next highest rate, disposal of the wastes at the site at which they were generated has yet a higher rate, and finally the highest rate is charged for disposal of the wastes off site at a commercial disposal facility.

A further exemption to the fees has been granted for wastes derived from the cleanup of a site pursuant to the *Act*, the state's *Solid Waste Management Act*, the federal *CERCLA*, and the federal *Solid Waste Management Act*.

The revenue from the fees are deposited into the state's Hazardous Sites Cleanup Fund and are used by the state to finance, in part, its hazardous waste management program. However, at least $2,000,000 is annually committed to provide capital grants for the purchase or lease of hazardous waste recycling equipment. The amount for each grant is capped at 25% of the installed cost of the recycling equipment.

The *Act* also imposed a "Host Municipality Benefit Fee" of $1 per ton of hazardous wastes received at a commercial hazardous waste treatment or disposal facility within a municipality's boundaries.[49] The fee is paid directly to the municipality.

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[48] Pennsylvania R.S. Title 35 Section 6020.903.

[49] Pennsylvania R.S. Title 35 Section 6020.306.

5.4 SUMMARY AND COMMENTS

Solid Waste Disposal Fees

Table 5-12 provides a summary of the solid waste disposal fees and taxes imposed by the U.S. states reviewed above. The fees currently range from a low of $0.20 per ton in Louisiana to a high of $4.00 per ton in Maine. Three of the state's collect the fees from landfill sites only while the remainder include other waste disposal facilities such as incinerators or resource recovery facilities.

Most states have imposed their solid waste fees to pay for the state's solid waste management programs but two states, Ohio and Colorado, have imposed solid waste fees to fund part of their hazardous waste management costs, in particular the cleanup of contaminated sites. All of the solid waste fees reviewed have their revenue deposited to a special solid or hazardous waste management account, or are credited directly to a state department for the funding of the state's solid waste management program.

Other features of the solid waste disposal fees reviewed above include:

- several states give local governments the power to impose fees on disposal facilities located within the local government's boundaries;
- some states have included sunset clauses in their legislation which automatically terminates the fees on a specific date;
- to recognize the administrative costs of collecting the fees some states allow facility operators to retain a percentage of the fees if payments by the facilities are remitted on time;
- two states, Illinois and Minnesota, provide exemptions for waste residues from recycling, resource recovery and energy-from-waste facilities provided the facility reduces the volume of its throughput by a minimum of 50% and 85% respectively;
- one state, Ohio, varies its fees according to the location from which the wastes originate relative to the disposal facility; and
- Maine imposes a further surcharge on wastes from municipalities which are not meeting the state's waste reduction goals.

TABLE 5-12

A SUMMARY OF SOLID WASTE DISCHARGE FEES AND TAXES IN THE UNITED STATES

(U.S. dollars)

Jurisdiction	Year Introduced	Rate	Annual Revenue (millions)
New Jersey	1982	0.12/cu. yd.	4.6
	1987	1.50/ton	15.0
Minnesota	1985	0.50/cu. yd.	1.8 (1988/89)
	1990	2.00/cu. yd.	-
Colorado	1986	0.15/cu. yd.	1.7
Illinois	1987	0.95/ton	16.2
	1989	1.27/ton	18.7
Ohio	1988	0.50-1.50	-
	1989	0.60-1.60	-
	1990	0.75-1.75	-
Pennsylvania	1988	2.00/ton	-
California	1990	0.50/ton	-
	1991	1.00/ton	-
Louisiana	1990	0.20/ton	-
Maine	1990	4.00/ton	-

Hazardous Waste Disposal Fees

Table 5-13 provides a summary of the hazardous waste disposal fees and taxes reviewed above. As shown the fees currently range from a low of $2 per ton, in Ohio and Pennsylvania, to a high of $103 per ton in California. The fee structure used by the states reviewed vary considerably which, in turn, provides a number of different incentives to waste generators in choosing their waste management and disposal options. Examples of the incentives that variations in the fee rates can provide includes:

- Method of Management - By varying the fees according to the method of disposal or waste management chosen by the waste generator the fees can provide an incentive for the generators to adopt "preferred management practices". Typically the fees exempt the recycling of hazardous wastes, provide a low rate for the treatment of wastes, a higher rate for deep well injection disposal, and the highest rate for landfill disposal of wastes. Other variations have provided reduction for disposal by incinerators and others for disposal to monofills or double lined impoundments.

- Type of Waste - The fees have also been varied according to the type of hazardous waste being disposed. Typically the variation is based on the relative degree of environmental and health risks associated with each waste type. Thus, the incentive provided by the fees for waste generators to reduce their production of waste increases as the relative risks associated with their wastes increases.

- Management of Wastes On or Off Site - The lowering of the fees for the disposal or treatment of the wastes on the site at which the wastes were generated provides an incentive for waste generators to undertake their waste management activities on site rather than transporting the waste to a facility off site. Management of the wastes on site eliminates the risks associated with the transportation of the wastes off site and may reduce the need for new hazardous waste management facilities and the siting problems associated with the facilities. Some jurisdiction, instead of varying the fee rates for on or off site waste management, provide a maximum monthly or annual fee cap for on site management, which is not available for off site management.

- Out of State Wastes - As many U.S. states are critically short of hazardous waste disposal and treatment facilities and are facing increasing difficulty in siting new facilities some states have imposed a higher fee rate for waste generated outside of their boundaries. For example, Maine doubles their fees for out of state wastes and Utah's fee rate is 2.5 times higher.

The state's reviewed also provide numerous exemptions to the fees for different classes of wastes. In particular the exemptions have been directed at wastes which are generated by state and local government waste management activities and by industrial pollution control activities. Examples of the exemptions include:

- hazardous wastes resulting from remedial actions taken at abandoned contaminates sites;
- sewage sludge from public treatment facilities;
- bottom ash and flyash from the incineration of municipal wastes;
- hazardous wastes collected as part of a household hazardous waste program; and
- flue gas desulphurization wastes.

Another significant difference in the fee structures adopted by the states reviewed is the point at which the fees are collected. Most state's collect the fees from the owner or operator of the waste disposal or treatment facility, for example, Illinois, Ohio, Maine, Louisiana, Utah and Pennsylvania do this, while a two states, California and Missouri, collect the fees directly from waste generators. The collection of the fees directly from waste generators will increase the administrative burden of the fee system as the number of waste generators is invariably larger than the number of waste disposal and treatment facilities. For example, when California changed its collection point, from disposal facilities to waste generators, the number of accounts increased by 6,000%.

TABLE 5-13

A SUMMARY OF HAZARDOUS WASTE DISCHARGE FEES AND TAXES IN THE UNITED STATES

(U.S. dollars)

Jurisdiction	Year Introduced	Rate	Annual Revenue (millions)
United States	1983	2.13/dry ton	3.1
California	1974	0.60/ton	
	1981	1.00/ton	
	1982	4.00/ton	
	1983	6.40 - 18.00/ton	
	1984	0.50 - 19.84/ton	
	1985	0.56 - 22.50/ton	
	1986	1.21 - 48.32/ton	
	1987	1.81 - 72.27/ton	
	1989	2.63-103.00/ton	
Illinois	1980	2.02/cu. yd.	
	1984	6.06/cu. yd.	
	1989	12.12/cu. yd.	1.98
	1990	15.15/cu. yd.	
	1991	18.18/cu. yd.	
Ohio	1980	2-7/ton	
Maine	1981	0.03-0.15/gallon	
	1987	10-40/ton	
Missouri	1983	25/ton	
Louisiana	1984	5-10/ton	
	1988	10-25/ton	
	1989	11-26/ton	8.6
	1990	12-27/ton	
Utah	1986	3/ton	
	1988	6-9/ton	
	1989	8-20/ton	
Pennsylvania	1989	2-12/ton	5.0

An advantage of collecting the fees directly from waste generators is the elimination of the incentive for generators to avoid paying the fees by disposing of the wastes at non-approved facilities or by illegal dumping. A disadvantage of collecting the fees from the waste generators is the need for all waste generators to be registered with the state and the need to have a system in place which can accurately monitor the volume of wastes produced by each generator.

SECTION SIX

REVISING BRITISH COLUMBIA'S FEE SYSTEM

6.1 INTRODUCTION

Before making any recommendations concerning any potential revisions to British Columbia's waste discharge permit fee system, it would be useful to summarize the major lessons learned from the review of waste discharge fee systems used by other jurisdictions. It will be important to try to incorporate these lessons into any potential revision of British Columbia's current discharge permit fee system. The review of the lessons learned is followed by the development of detailed recommendations for revising British Columbia's current permit fee system.

6.2 LESSONS LEARNED FROM OTHER JURISDICTIONS

There are seven major lessons to be learned from the manner in which other jurisdictions have implemented waste discharge fee systems. Each of these lessons is described below and is accompanied by a discussion of how the lesson could be incorporated into British Columbia's discharge fee system.

1. Fees are Used to Complement a Permit System

Discharge permit fees have not been used as a substitute for a discharge permit system, but rather as a complement to the direct regulatory approach. In this way, the economic incentive and direct regulatory approaches to pollution control have been pragmatically blended in order to achieve most of the benefits available from both approaches. The major advantage of the direct regulatory approach is the relative certainty that the permittees will take some actions to reduce their discharges. The major disadvantage is that there is no ongoing incentive for the permittees to reduce their discharges below the limits set by the permit. The major advantage of the economic incentive approach is that it will provide a dynamic ongoing incentive for permittees to reduce their discharges while the major disadvantage is that there is no certainty that an individual permittee will undertake any reductions.

British Columbia has had a permit system in place to control waste discharges since 1971. This system has made a significant contribution to environmental protection in the province over the last 28 years. It would seem rather foolish to completely abandon this system in favour of a strict system of economic incentives. Rather, the current permit fee system could be modified to base the fees on the quantity and quality of the wastes authorized to be discharged by a permit. In this manner, economic incentives could be brought into the province's system of environmental management as a complement to the current discharge permit system.

2. Fees Vary by Quantity and Type of Pollutants Discharged

All jurisdiction reviewed based their fees on estimates of the quantity of pollutants each source discharges. In addition, most jurisdictions have imposed fee systems which vary by the type of pollutants discharged. The fee for each pollutant type are usually set based on the relative treatment cost of each pollutant or on the pollutant's potential damage to the environment.

In British Columbia, the provincially established air and water quality objectives plus the pollution control objectives for each industry could be used as the basis for determining the relative environmental impact of most pollutant types. These relative impacts could be used as the basis for varying the fees by the type of pollutant discharged.

3. Simplified Measurement of the Pollutants Discharged

All jurisdictions have attempted to minimize the scope and costs of measuring the pollutants discharged from each source. Some have done this by limiting the number of pollutants measured, others by basing the fees on the permit's maximum authorized discharge levels, and still others by limiting the direct measurement to large dischargers only. For this last approach, the small dischargers usually have their fees assessed using a set of standardized production coefficients.

For British Columbia, the simplest method of approximating the quantity of pollutants discharged from each source would be to base the measurement on the maximum quantities and qualities of waste discharges authorized by a waste discharge permit. The Environmental Protection Division is currently developing a computerized data system which will contain all relevant permit information. Once the waste data system is in place, the retrieval of the necessary information will be a simple process. The measurement of pollutant discharges in this manner would maintain the economic incentive of the fees as a permittee can always reduce his total fee payments by applying for a reduction in his authorized discharge rates. The amendment of a permit is a relatively simple process when a reduction in authorized waste discharges is applied for. Such a system would be similar to the one adopted by West Germany for its national effluent fees.

However, in order to maintain flexibility in the waste discharge permit fee system, it may be advisable to allow the fee to be calculated on the actual discharges by a permittee based on data submitted by the permittee and approved as correct by the regional waste manager. The West German effluent fee system has a similar provision.

4. Fees Vary Geographically within a Jurisdiction

In many cases, the fees are not constant across a jurisdiction but vary according to the area within the jurisdiction into which the discharges are made. The basis for varying the fee has included:

- the relative sensitivity of the receiving environment to the pollutant being discharged;
- the relative treatment cost within each area; and
- the relative air or water quality objectives set for each area.

The fee system in British Columbia could also be revised to allow for variations in the fees according to the area into which the discharges are made. At least two approaches could be used as the basis for varying the fees within British Columbia. First, if the ambient air or water quality objectives for an area are being exceeded, the fees could be increased by some percentage to reflect the diminished capacity of the environment to accept pollutants. Second, the current permit system contains an environmental impact assessment procedure which provides a numerical index of potential or actual impact of the permit's discharges on the environment. This index could also be used as the basis for varying the fee.

5. Fees Originally Set Low and Raised Over Time

In all jurisdictions reviewed, the discharge fees were originally set quite low but have been raised over time. In most cases, the increases in fees have been due to rising treatment or compensation costs while in other cases, for example West Germany, a transitional period was specified over which the fees were gradually raised to their final full level. Naturally, as the fees have been increased, the incentive effect of the fees has also been increased.

In British Columbia, the fees could originally be set to recover provincial regulatory costs alone and expanded over time to recover any other costs associated with waste discharges. For example, the fees could in the future be used as the means of funding provincial capital cost grants for waste treatment facilities.

6. Fees are Used to Finance Discharge Abatement Measures

The revenues generated by the fee systems have in most cases been used in whole or in part to subsidize the discharge abatement and waste management measures undertaken by municipalities and, in some jurisdictions, by industries as well. This approach not only relieves general government revenue from the funding of abatement subsidies but also reduces objections to the imposition of a fee.

The fees collected in British Columbia could be directed to a special account for the financing of pollution control measures rather than becoming part of general government revenue. For example, the fees collected could be used to finance, in part, programs such as the current municipal sewerage grant program which is now funded by the *Revenue*

Sharing Act.[1] Consideration could also be given to the expansion of the capital grant subsidy program to include the construction of industrial waste treatment facilities.

The recently passed *Sustainable Environment Fund Act*, now specifies that revenues derived from waste management permit fees will be deposited into the Sustainable Environment Fund.[2] Monies in the fund will be used to finance provincial waste management initiatives.

7. Fees Have Contained a Hardship Relief Clause

In order to avoid the potential for serious economic disruptions, several jurisdictions have included an economic hardship clause which allows for temporary relief from the payment of the discharge fees. In some cases, this relief was only available during a transitional period during which the fees were introduced.

In British Columbia, the *Waste Management Act* contains a provision which allows the Minister of Environment to issue a "variance order" whenever he "considers that a person should have temporary relief from the requirements of" the permit.[3] It would seem reasonable, at least during some transitional period, to offer similar relief from the payment of the fees where severe economic hardship can be demonstrated.

6.3 COMPONENTS OF A PERMIT FEE

It is recommended that the revised discharge permit fee have a two part structure: a fixed fee component (FF), and a variable fee component (VF). Thus, the total fee (TF) for each discharge permit would be calculated as:

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[1] *Revenue Sharing Act*, R.S.B.C. 1979, c. 368.

[2] *Sustainable Environment Fund Act*, S.B.C. 1990.

[3] Section 13 of the *Act*.

$TF = FF + VF$.

The Fixed Fee Component

This component would represent the base amount required to cover the minimum administrative costs of maintaining any discharge permit regardless of the permit's authorized level of discharges. The fixed fee component for each permit type could be taken as being equal to the minimum fee charged under the current permit fee system, which for each permit type is:

• air emission permit	$100.00
• effluent discharge permit	$75.00
• refuse permit	$50.00

The Variable Fee Component

The variable fee component would, in most cases, be the major part of the total permit fee and could be based on the permits' maximum authorized level of waste discharges or on the permittee's actual discharges based on data submitted by a permittee and approved by the regional waste manager. A fee for each type of pollutant would be developed, as discussed below, based of the relative environmental impact of each pollutant type. The variable portion of the fee would be calculated as:

$$VF = \sum_{i=1}^{n} PF_i \times Q_i$$

where: VF = total variable fee for a permit;

PF_i = the fee per unit of pollutant type i;

Q_i = the maximum annual quantity of pollutant type i a permit holder is authorized to discharge;

i = pollutant type; and

n = the total number of pollutant types.

6.4 DETERMINING THE RELATIVE IMPACT OF POLLUTANTS

Within each discharge medium (air, water and land), the fees for each type of pollutant discharged should be based on the relative damage each pollutant may potentially cause to the environment. For example, if air emissions of total reduced sulphur (TRS) potentially causes five times more damage than air emissions of particulate matter, then a fee for a tonne of TRS should be five times greater than for a tonne of particulates. The provincial air and water quality ambient objectives and pollution control objectives could be used to determine the relative weights assigned to each pollutant type discharged to air or water. For solid wastes, the fees could be based on the type of material being landfilled, ie. special wastes, mixed municipal wastes, or inert industrial wastes

Table 6-1 presents the 1-hour and 24-hour B level air quality objectives for 22 pollutants which have been taken from the provincial pollution control objectives for various industries. The B level objectives are the maximum concentrations of pollutants established to provide adequate protection against adverse effects on human health and comfort. In this example, particulates have been arbitrarily chosen as the base pollutant against which the relative environmental impacts of the other air pollutants can be measured.[4] Table 6-1 shows that 200 micrograms per cubic meter of particulates has the same rating as 300 micrograms per cubic meter of nitrogen dioxide. Thus, nitrogen dioxide is assigned a weight of 2/3 relative to particulates. The weights for the other pollutants can be calculated in a similar manner, as shown in the right hand column of Table 6-1.

Table 6-2 presents typical water quality B level effluent objectives from the various provincial pollution control objectives. The relative environmental impact weights have been calculated using suspended solids, again chosen arbitrarily, as the base pollutant.

The method used for weighting the pollutants contained in air emissions and effluent discharges cannot be used for refuse discharges.

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[4] The choice of which pollutant to use as the base unit will not $\overset{a}{\text{e}}$ffect the analysis.

TABLE 6-1

AIR QUALITY B LEVEL OBJECTIVES

(micrograms per cubic meter)

Pollutant	1 - Hour	24 - Hour	Weight
Particulate		200	1.000
Nitrogen Dioxide	1000	300	0.667
Ozone	160	50	4.000
Sulphur Dioxide	900	260	0.769
Total Reduced Sulphur	28	6	33.333
Chlorine and Chlorine Dioxide		300	0.667
Carbon Monoxide	28000		0.025
Antimony		0.5	400.0
Arsenic		1.0	200.0
Beryllium		0.1	2,000
Cadmium		0.3	666.7
Chromium		0.1	2,000
Copper		2.5	80.0
Fluorine		2.0	100.0
Lead		2.5	80.0
Mercury		1.0	200.0
Molybdenum		2.5	80.0
Nickel		O.1	2,000
Selenium		0.5	400.0
Uranium		6.0	33.33
Vanadium		1.0	200.0
Zinc		2.5	80.0

Source: British Columbia, 1974, 1975a, 1975b, 1977, 1979.

TABLE 6-2

TYPICAL WATER QUALITY EFFLUENT OBJECTIVES

Pollutant Type	Concentration (mg/litre)	Weight
Suspended Solids	75.0	1.0
BOD	50.0	1.5
Oil and Grease	15.0	5.0
Ammonia	10.0	7.5
Nitrates	25.0	3.0
Chlorine (Cl)	0.5	150
Phenol	0.3	250
Phosphate (as P)	10.0	7.5
Sulphate	250	0.3
Sulphide	1.0	75
Aluminum	1.0	75
Antimony	1.0	75
Arsenic	1.0	75
Barium	1.0	75
Boron	5.0	15
Cadmium	1.0	75
Chromium	0.3	250
Cobalt	1.0	75
Copper	0.3	250
Cyanide (as CN)	0.5	150
Fluoride	10.0	7.5
Iron	1.0	75
Lead	0.2	375
Manganese	1.0	75
Mercury	0.005	15,000
Molybdenum	5.0	15
Nickel	1.0	75
Selenium	0.5	150
Silver	0.5	150
Tin	5.0	15
Zinc	1.0	75

Source: British Columbia 1974, 1975a, 1975b, 1977, 1979.

Due to the heterogenous nature of domestic and industrial refuse, refuse permits do not specify the individual pollutants contained in the solid waste stream. Instead, the permits classify the solid wastes as either hazardous wastes, mixed municipal wastes and inert wastes. No obvious method of weighting these refuse types was available so the following, rather arbitrary, weighting schedule is proposed:

Refuse Type	Weight
Hazardous Wastes	1.5
Mixed Municipal	1.0
Inert	0.5

The specification of the pollutant weights provides us with a means of summing up the total discharges of all pollutant types to each discharge medium. The total quantity of pollutants being discharged to a medium can be calculated as follows:

$$TUP = \sum_{j=1}^{m} \sum_{i=1}^{n} W_i \times Q_{ij}$$

where: TUP = the total standardized units of pollutants discharged to a medium;

W_i = the environmental impact weight assigned to pollutant type i;

Q_{ij} = the total annual quantity of pollutant type i authorized to be discharged by discharge permit j;

i = pollutant type;

j = the discharge permit;

n = the total number of pollutants; and

m = the total number of discharge permits.

TABLE 6-3

SHARE OF TOTAL PERMIT SYSTEM COSTS ATTRIBUTABLE TO EACH PERMIT TYPE

Permit Type	Percent	Share	Permits
Air Emission Permits	40%	$8.4 million	1,044
Effluent Discharge Permits	40%	$8.4 million	1,444
Refuse Permits	20%	$4.2 million	854
Total	100%	$21 million	3,346

6.5 CALCULATING THE VARIABLE FEE FOR EACH POLLUTANT TYPE

The variable fees could be set separately for each permit type (air emission, effluent and refuse) so as to cover the total permit system costs associated with each permit type. The estimated portion of the $21 million total permit system cost associated with each discharge permit type is shown in Table 6-3.

Subtracting the total fixed fees associated with each permit type from each permit type's share of the total permit system cost will yield the variable fee portion of total permit system costs as shown below in Table 6-4. The fixed fee totals are calculated by multiplying the number of permits in each permit type by the fixed fee for that permit type: $100 for air permits, $75 for effluent permits, and $50 for refuse permits.

A base variable fee (Base) for each standardized unit of pollution could be calculated by dividing the variable fees portion (VFP) of total costs shown in Table 6-4 by the total number of pollutant units discharged (TUP) to each medium, or:

TABLE 6-4

PORTION OF TOTAL COSTS TO BE BORNE BY EACH FEE COMPONENT

Permit Type	Share of Total Cost ($)	Fixed Fees ($)	Variable Fees ($)
Air	8,400,000	104,400	8,295,600
Effluent	8,400,000	108,300	8,291,700
Refuse	4,200,000	42,700	4,157,300
Total	21,000,000 100%	255,400 1%	20,744,600 99%

Base = VFP / TUP.

The variable fee for each pollutant type (PF_i) can be calculated next by multiplying the base fee by the appropriate pollutant impact weight, or:

$PF_i = Base \times W_i$.

6.6 AN EXAMPLE OF CALCULATING THE VARIABLE FEES

Unfortunately data on the total authorized discharges for each pollutant type are not available and will not be available until the Environmental Protection Division's Waste Information System is functioning, which is slated for the fall of 1990. However, the following is a hypothetical example of how the variable fees could be calculated using the methods developed above. The example used is for air emission permits, but for five pollutant types only; particulates; sulphur dioxide; nitrogen dioxide; hydrocarbons; and carbon monoxide. These pollutants were chosen because estimates of the total annual provincial point source emissions of these pollutants, and only these pollutants, were available (British Columbia, 1989). In this example it will be assumed that the total variable fee portion of total permit system costs to be borne by air emission permits is $8,295,600, as shown in Table 6-4.

Table 6-5 presents estimates of the total annual emissions of the five pollutant types, the relative environmental impact weights from Table 6-1, and the weighted total emissions for each pollutant. Dividing the air emission permits' variable fee portion (VFP) by the total weighted emissions (TUP) yields the base variable fee of :

$8,295,600 / 304,037 tonnes = $27.28/tonne.

The variable fee for each pollutant type can be calculated next by multiplying the base variable fee by the pollutant weight as shown in Table 6-6. The table shows the fees for individual pollutants varying from a low of $0.68 per tonne to a high of $27.28 per tonne.

TABLE 6-5
CALCULATION OF WEIGHTED TOTAL EMISSIONS

POLLUTANT	TOTAL 1985 EMISSIONS (tonnes) (a)	POLLUTANT WEIGHTS (b)	WEIGHTED TOTAL EMISSIONS (tonnes) (a x b)
Particulates	132,916	1.000	132,916
SOx	88,995	0.770	68,526
NO	47,181	0.670	31,611
HC	55,632	1.000	55,632
CO	614,072	0.025	15,352
Totals	938,796	n.a.	304,037

TABLE 6-6

CALCULATION OF EMISSION FEES BY POLLUTANT TYPE

POLLUTANT	BASE FEE ($ / tonne)	WEIGHT	FEE ($ / tonne)
Particulates	27.28	1.00	27.28
SOx	27.28	0.77	21.01
NOx	27.28	0.67	18.28
HC	27.28	1.00	27.28
CO	27.28	0.025	0.68

It would be useful at this point to compare the fees that representative firms would pay under the current fee system and the fee system from our hypothetical example. For this purpose the air emission permits of a pulp mill, a sawmill and a shake mill were selected. Under the current fee system the pulp mill pays a fee of $20,000, the sawmill $5,600 and the shake mill $2,400. The fees for these three permits under the hypothetical fee system are calculated in Table 6-7. By comparison the new system would increase the fees of the pulp mill by a factor of 15, would triple the fees of the sawmill and leave the fees of the shake mill almost unchanged. Basing the fees on the quantity of pollutants emitted would appear to provide a far more equitable system.

TABLE 6-7

AN EXAMPLE OF CALCULATING AIR EMISSION FEES

Plant Type	Pollutant	Emissions	Unit Fee*	Total Fees*
Pulp Mill	Part.	7214.3	27.28	196,806.10
	SO_x	3635.8	21.01	76,388.16
	NO_x	1356.4	18.28	24,794.99
	HC	506.7	27.28	13,822.78
	CO	3070.0	0.68	2,087.60
				100.00
				313,999.63
Sawmill	Part	499.7	27.28	13,631.82
	SO_x	9.8	21.01	205.90
	NO_x	46.5	18.28	850.02
	HC	7.2	27.28	196.42
	CO	228.0	0.68	155.04
				100.00
				15,139.20
Shake Mill	Part.	28.8	27.28	785.66
	SO_x	0.4	21.01	8.40
	NO_x	4.2	18.28	76.78
	HC	45.2	27.28	1,233.06
	CO	533.0	0.68	362.44
				100.00
				2,566.34

* Hypothetical example only.

6.7 METHODS OF VARYING THE FEES BY AREA OF DISCHARGE

In the review of the lessons learned from other jurisdictions, it was suggested that there are at least two approaches which can be used as the basis for varying the fees by area of discharge - an ambient air and water quality objective approach and a environmental impact assessment approach. Both of these methods are discussed in more detail below and are followed by a brief assessment of the Ministry's current ability to implement either approach.

Ambient Air and Water Quality Objectives

The first approach which could be used is to base the variation in fees on the local ambient air and water quality objectives. In this approach, the variable component of the fees could be increased by some factor if the area into which the discharges are to be made was not currently meeting its ambient air or water quality objectives. For example, if an area was not meeting its ambient air quality objective for SO_x then the fee for SO_x emissions could be doubled. The approach could be further refined to provide a buffer for the ambient objective. For example, if the area's current concentration of SO_x was greater than 75 percent of the maximum ambient objective, then the fee for SO_x could be increased by a factor of 1.5. However, the use of this approach requires that air and water shed boundaries be developed and that local air and water quality ambient objectives be set.

Environmental Impact Index

The Waste Management Branch has developed a permit compliance strategy for assessing its priorities for permit enforcement and review. As part of this strategy, an assessment of the potential environmental impact associated with each permit is conducted which uses six criteria to develop a numerical index of the relative environmental risk. The six criteria are: quantity of discharge, quality of the receiving environment relative to Ministry ambient objectives, dilution capability, intended use of the receiving environment, public sensitivity and potential human safety. Attached as an appendix are the tables used to rate each of the six criteria. For air emission permits, the numerical rating of the permit's risk ranges from zero to 18.5. However, under the strategy, any rating of 10 or more is considered to have a high potential environmental impact.

An environmental sensitivity multiplier for a pollutant could be constructed to increase the variable fee portion of the fee for permits with a high environmental assessment index. For example, it will be assumed, arbitrarily, that the maximum desired increase in the variable fees would be 100% and that any environmental risk rating at or above 10 points would lead to the maximum increase. Using these assumptions, the multiplier could be calculated as:

$$M_i = 1 + R/10, \quad 1 \leq M_i \leq 2$$

where M is the multiplier and R is the environmental risk rating. The multiplier would then be applied to the variable fee portion of the total permit fee as follows:

$$TF = FF + \sum_{i=1}^{n} PF_i \times Q_i \times M_i.$$

Assessment

Both of the methods described above could be used as the basis for varying the fees by area of discharge. However, it is suggested that further work is required before either of these methods could be adequately implemented. The use of ambient air and water quality objectives requires that air and water shed boundaries be identified and that local ambient objectives be set. Neither of these tasks has been completed for all areas of the province. While the environmental impact assessment index is in place for all permits, Ministry staff believes that further refinements are required before the index could be used as a completely objective method of rating the environmental impacts across all regions of the province. For these reasons, it is recommended that the variation of discharge fees by area of discharge be delayed pending further development research.

6.8 CONCLUSION

Revising British Columbia's current waste discharge permit fee system to base the fees on the quantity and type of pollutants discharged has the potential to achieve each of the four objectives discussed in Section 1.6:

Economic Efficiency - The fees will cause polluters to internalize at least some of the external costs associated with their waste discharges. The fees could initially be set to recover the discharge permit system's regulatory costs and expanded over time to include other environmental costs as these costs are identified. The fees would also promote the conservation of the environment's natural assimilative capacities.

Economic Incentive - The fees, by varying by type and quantity of pollutant discharged, will provide an ongoing incentive for polluters to reduce their discharges. By basing the fee rate for each pollutant type on the pollutant's potential environmental impact will provide polluters with a greater incentive to reduce the discharges of potentially more harmful pollutants.

Cost Recovery - The fees can be set to fully recover the costs of the province's waste management function.

Equity - Not only is the current permit fee system inequitable in its treatment of different industries and between firms within an industry group, it is also inequitable in that not all of the regulatory costs of the waste permit system are recovered from waste dischargers. Thus, society is currently subsidizing the regulatory costs which are directly attributable to waste discharges. Revising the fees to fully recover all regulatory costs and basing the fees on the quantity and type of waste discharged by a permittee will remove these inequities.

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APPENDIX

ENVIRONMENTAL IMPACT INDEX RATING TABLES

TABLE I

CRITERIA	RATING FACTORS	RATING
Quantity of Discharge	Effluent Discharge $> 500\ m^3/d$ Air Discharge $> 7\ 200\ m^3/min$* (5000 mol/s) Refuse Discharge $> 250\ m^3/d$	1
	Effluent Discharge $\leq 500\ m^3/d$ and $\geq 50\ m^3/d$ Air Discharge $< 7\ 200\ m^3/min$* (5000 mol/s) and $\geq 145\ m^3/min$* (100 mol/s) Refuse Discharge $\leq 250\ m^3/d$ and $\geq 25\ m^3/d$	1/2
	Effluent Discharge $< 50\ m^3/d$ Air Discharge $< 145\ m^3/min$* (100 mol/s) Refuse Discharge $< 25\ m^3/d$	0

*Standard Conditions:

Standard temperature = 293.15 Kelvin (K)

Standard pressure = 101.325 Kilopascals (kPa)

Water vapour content - unless otherwise stated shall be equal to zero

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TABLE 2

CRITERIA	RATING FACTORS	RATING
Quality of Receiving Environment in Relation to Ministry Ambient Objectives.	Ambient Water Quality Objectives:*	
	Exceeded > 30% of time	9
	Exceeded > 0% and ≤ 30% of time	6
	Water Quality Objectives attained with up to a 20% safety factor	3
	Water Quality Objectives attained with more than a 20% safety factor	0
	Ambient Air Quality Objectives	
	Level B exceeded for more than 3 hours per day	9
	Airshed objective not attained	6
	Airshed objective attained with up to a 20% safety factor	3
	Airshed objective attained with more than a 20% safety factor.	0
	*Water Quality Objectives refer to groundwater, marine and fresh surface water.	

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TABLE 3

CRITERIA	RATING FACTORS	RATING
Dilution Capability and Sensitivity of Receiving Environment **Note:** Only report highest number selected	**Effluent to Water**	
	Initial Dilution < 20:1	3
	Initial Dilution ≤ 200:1 and ≥ 20:1	1
	Initial Dilution ≤ 2 000:1 and ≥ 200:1	1/2
	Initial Dilution > 2 000:1	0
	Effluent and Refuse to Land (Proximity to Sensitive Water Body or Potable Water Well)	
	< 100 m	3
	> 100 m and ≤ 500 m	1
	≥ 500 m and ≤ 1 000 m	1/2
	> 1 000 m	0
	Emissions to Air and Refuse to Land (Distance to Population Centres)	
	< 2,000 m	1 1/2
	≤ 2,000 m and ≥ 10 000 m	1/2
	> 10,000 m	0

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TABLE 4

CRITERIA	RATING FACTORS	RATING
Actual or Intended Uses of Receiving Environment Note: Only report highest number selected	1. Receiving Waters affected by direct effluent discharge or by leachate	
	a) Used as a Drinking Water Source	
	< 1 000 m downstream	4
	≥ 1 000 m and ≤ 10,000 m downstream	2
	> 10,000 m	0
	b) High Fisheries Resource Value	3
	Medium Fisheries Resource Value	2
	Low Fisheries Resource Value	1
	No Fisheries Resource Value	0
	c) Used for Water Contact Recreation Such as Swimming, Water Skiing, etc.	
	< 1 000 m downstream	2
	≥ 1 000 m and ≤ 10,000 m downstream	1
	> 10,000 m downstream	0
	2. Ambient Air	
	Level A Category	2
	Level B Category	1
	3. Land - Effluent Disposal	
	Public Access to Within < 10 m	2
	Public Access to Within ≥ 10 m and < 1 000 m	1
	Public access to Within > 1 000 m	0

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TABLE 5

CRITERIA	RATING FACTORS	RATING
Public/Agency Sensitivity	High Sensitivity	3
	Medium Sensitivity	2
	Low Sensitivity	1
	No Public or Agency Concern	0

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TABLE 6

CRITERIA	RATING FACTORS	RATING
Potential and Actual Human Safety and Health Note: Only report highest number selected	(1) **Refuse**	
	Serious Bear/Human Conflict	2
	Some Bear/Human Conflict	1
	No Bear/Human Conflict	0
	(2) **Health**	
	Serious Threat to Human Health Due to Contact with Discharged Effluent or Air Contaminants.	2
	Some Threat to Human Health Due to Contact with Discharged Effluent or Air Contaminants.	1
	No Threat to Human Health Due to Contact with Discharged Effluent or Air Contaminants.	0
	(3) **Special Waste**	
	Significant quantities of special waste stored on site.	2
	Small quantities of special waste stored on site.	1
	No special wastes stored on site.	0

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